INTERNATIONAL
MARINE ENGINEERING
Published Monthly by the ALDRICH PUBLISHING COMPANY
6 EAST 39th STREET, NEW YORK — 8 BOUVERIE ST., LONDON, E. C.
Edited by H. H. Brown
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Vol. XXIV — APRIL, 1919 — No. 4

Chairman Hurley's Plan for the Operation of the New American Merchant Marine

THE operation of a fleet of 16,000,000 tons of merchant vessels, 70 percent of which is owned by the Government, is a problem which faces the Government and people of the United States for immediate solution. To-day the Government owns 555 ocean-going steel cargo ships, aggregating 3,385,475 deadweight tons, and, in addition, has under contract 1,336 similar vessels of 9,375,006 deadweight tons. If the present shipbuilding programme is carried out, there will be under the American flag next year 16,732,700 deadweight tons of ocean-going steel cargo and passenger ships, or a fleet equivalent to almost half the merchant tonnage which plies the seas to-day under the flags of all nations combined.

As a solution of this problem, Edward N. Hurley, chairman of the United States Shipping Board, in an address delivered at the annual dinner of the National Marine League in New York on March 27, proposed the following plan:

"The ships should be sold to and operated by American citizens under no restrictions other than the terms of the bill of sale and the fixation of maximum freight rates, either as provided in Section 18 of the Act approved September 7, 1916, or as may be agreed by the Government and the operator in specific instances.

"The ships should be sold at a price which fairly reflects the current world market for similar tonnage.

"Twenty-five percent of the purchase price of each ship should be paid down, the remainder falling due and payable in graded annual instalments over a period not exceeding ten years. The Government should take and hold a mortgage for the unpaid balance, charging interest thereon at the customary commercial rate of five percent. One-fifth of this interest, representing the difference between the customary Government interest of four percent and the customary commercial rate, should be paid into a Merchant Marine Development Fund to be described hereafter.

"The purchaser should be required to agree to insure, and keep insured, with an American marine insurance company his equity in the vessel, and because the American marine insurance market has not at present sufficient resources to underwrite all the vessels the Government has to sell, the Government should carry in its own fund, as at present, but for purchaser's account, hull and machinery insurance covering that part of the vessel for which payment has not been made. Our experience in operation shows that the Government can carry this insurance for at least one percent less than the open market rate. However, it is proposed that the open market rate be charged, and that the difference be paid into the Merchant Marine Development Fund.

"It is understood that no transfer of a vessel to foreign registry should be permitted without express permission of the Government.

"Each purchaser who wishes to operate in the foreign trade should be obliged to incorporate under Federal charter, the necessary legislation for which should be passed by Congress without delay. Such a charter should provide that no stock shall be issued in excess of the money value actually paid in on vessel property, and that no stock can be issued or transferred to an alien.

"It should also provide that one member of the Board of Directors for each company shall be named by the Government. This director should draw no salary, either from the steamship corporation or from the Government. He should receive only the customary director's fee for each meeting he attends.

"The same legislation should provide for periodical meetings of these Government-named directors in the city of Washington, where they will constitute an official body which will confer with and advise the Shipping Board, or other designated Government agency, upon problems arising in, or questions affecting the welfare of, the American merchant marine, including the administration of the Merchant Marine Development Fund.

"This fund, drawn from the sources previously indicated, should be used to relieve such financial difficulties as may be encountered in the development of an adequate and well-balanced American merchant marine. For instance:

"It is foreseen that a number of trade routes important to the immediate or future welfare of American commerce must be established and developed. Some of these routes may not yield steamship operating profits until their existence shall have attracted an increased volume or better balance of trade. Revenue derived from the carriage of mail, and possible fees for the training of seamen and cadet officers, may partly compensate losses incurred on these routes. Still, in cases where the Government sells a ship upon condition that it be operated in a route which may not prove profitable at once, it will be necessary to provide for the payment of defaulted interest from the

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Merchant Marine Development Fund, in the discretion of the Shipping Board or other Government agency, upon recommendation of the Board of Government Directors, until such time as the route may begin to yield profit. When the ships in the route earn their annual interest rate and a profit, one-half the profit earned each year should be paid into the Merchant Marine Development Fund until all moneys drawn from the fund on account of the vessel in question shall have been replaced. The other half should go annually to the steamship stockholders.

"Such vessels cruising in routes which fail to prove susceptible of profitable development, and which do not serve any purpose of the Government of the United States, may be transferred by the Government to other routes. However, should the Government become convinced that any vessel has failed to make expenses solely or chiefly because of incapable management, it may foreclose its mortgage on that vessel.

"On the basis of one billion dollars' worth of ships, the Merchant Marine Development Fund would be, for the first year, fourteen million dollars. This amount, investigation convinces me, would be more than sufficient to care for all deficiencies likely to develop during this period.

"Until sold under the terms just stated, all vessels should remain the property of and should be operated by the Government of the United States."

In order to make this plan effective, according to Mr. Hurley, it will be necessary to ask Congress for only three statutes: One, to authorize the incorporation of steamship companies under Federal charter along the lines proposed; another, to extend the Emergency Board to carry hull and machinery insurance in the Shipping Board's fund so that this function may continue to be performed by some designated Government agency so long as the Government may continue to hold an equity in any of the vessels it now owns or has under contract; and a third statute to revise the present status of vessel mortgages so as to make them attractive to bankers and other investors.

Mr. Hurley's plan for the operation, or rather the sale, of the new American merchant marine is remarkable for its failure to take into consideration conditions which are at the bottom of the successful operation of a merchant fleet rather than for the things which he proposes to do. Mr. Hurley states that personally he is opposed to Government ownership, except as a last resort. So is practically everyone else who appreciates the difficulties of operating the merchant marine, but Mr. Hurley admits that our foreign trade and the operation of American ships will decline unless there is a profit for the men who invest their money in this enterprise.

What assurance does Mr. Hurley's plan give to investors that these vessels can be operated profitably? Shipping men and other investors have always had the opportunity of buying vessels at current market prices and engaging in the shipping business subject to the navigation laws of the United States. But past experience has shown that existing laws make the cost of operation of American vessels so high that it is practically impossible for American shipping interests to compete for foreign trade. Mr. Hurley's plan ignores this condition entirely and makes no provision for overcoming the paramount obstacle in the operation of the American merchant marine—that is, the high cost of operation.

The terms under which Mr. Hurley proposes to sell the Government ships to private interests are perhaps as favorable as could be desired, except that many will undoubtedly believe that it would be a wiser policy to extend the time of payment for a longer period—say twenty years instead of ten years, as proposed. It is quite true that the economic importance of this great fleet will be difficult to overestimate and that the future development of our overseas trade and of the domestic industries which feed it will depend more upon the successful operation of the merchant marine under a sound financial and administrative plan than upon any other factor. Mr. Hurley points out that under private ownership the man who enters the shipping business enters a battle against the wits of the world and that his success depends upon something closely akin to genius. It would indeed be a resourceful and skillful ship operator who could accept the burdens imposed by American shipping laws and, with no other assistance than the opportunity to purchase as many vessels as he could afford to buy under current market prices, achieve success in foreign commerce against the world's competition.

An attempt is made in this plan to relieve such financial difficulties as may be encountered in the early stages of development of new steamship lines by means of a Merchant Marine Development Fund, which, on the basis of a billion dollars' worth of ships, it is estimated will amount to about $14,000,000, and which will be administered by the Shipping Board or some other Federal agency. This fund is created by the setting aside of certain moneys representing the difference between the customary commercial charges for interest and insurance and the rates at which the Government in virtue of its peculiar position is enabled to charge. It is assumed that any disbursements which may be made from this fund during the first few years will be returned during the last few years of the ten-year period required for the payment of the vessels. Assuming that the money will be placed in an approved depository where it can draw interest at 2 percent compounded semi-annually, it is estimated that the size of the fund for the ten-year period will amount to over $83,000,000. The assistance which it is proposed to render with this fund is to take the place of Government backing for the development of new trade routes in the national interest. It is pointed out that not one cent of this fund is drawn from the public treasury; instead, the money represents profits foreborne by the Government, which is not entitled to earn profit while engaged in developing the industries of its people.

If, under the conditions which exist, there should be a ready market among American investors for the Government ships, the success of this plan might be assured, but unless some more definite plan is devised for meeting competition in overseas commerce, it seems quite likely that the Government will have some difficulty in disposing of its enormous fleet under the terms proposed. In that case a large part of it will remain under Government ownership, and, as it is inconceivable that this fleet will be kept idle, private owners will find that they may be forced into competition with a not inconsiderable Government-owned and operated merchant fleet—a prospect which cannot be viewed without misgiving.

Mr. Hurley's opposition to Government ownership, his zeal in safeguarding the public from exploitation and his broad conception of the economic value of the merchant marine to the nation and its future welfare and prosperity will meet with universal approval. But, to use his own words, "Our first thought must be of the effect of any inadequate solution upon the 100,000,000 people who compose the United States; their interests must come first."

We have no apprehension of the results if American shipowners can meet their competitors on even terms, but until the inequalities in the cost of building and operating vessels are disposed of, the future of the American merchant marine under private ownership is necessarily uncertain and obscure.

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Our Staff of Contributing Editors

IN order to increase the usefulness of Marine Engineering to its readers in dealing with the varied problems arising in the present-day development of naval architecture, marine engineering, shipbuilding and ship operation, we take pleasure in announcing as a part of our organization the following staff of contributing editors: Professor C. H. Peabody, head of the department of naval architecture and marine engineering of the Massachusetts Institute of Technology; William Gatewood, naval architect, Newport News Shipbuilding & Dry Dock Company; Rear Admiral C. W. Dyson, U. S. N., head of the designing department of the Bureau of Steam Engineering of the Navy Department; Captain C. A. McAllister, engineer-in-chief of the United States Coast Guard Service; Commander S. M. Robinson, U. S. N., of the Bureau of Steam Engineering; William T. Donnelly, consulting engineer, and H. McL. Harding, consulting marine terminal engineer.

Shipping Board Appropriations, Contracts and Cancellations

IN order to set at rest any misapprehensions regarding the resources and future plans of the Emergency Fleet Corporation for shipbuilding, caused by the signing of the armistice and later by the failure of Congress to make the appropriations asked for by the Shipping Board, Marine Engineering has secured from Charles Piez, director-general of the Emergency Fleet Corporation, the following statement outlining the present status of the shipbuilding programme, appropriations available and cancellations so far made:

The net programme of steel cargo, tanker and troopship construction, after deducting deliveries, suspensions and cancellations, is as follows: One thousand and twenty-five cargo ships of 7,016,502 deadweight tons, 81 tankers of 737,320 deadweight tons, and 66 troopships of 655,150 deadweight tons, or a total of 8,408,972 tons yet to be built. Work on wooden ships has been brought almost to a standstill. Cancellations of steel ship construction, beginning with the armistice, cover 156 cargo ships of 1,296,525 deadweight tons, 29 tankers of 268,200 deadweight tons, 35 troopships of 280,000 deadweight tons, 9 requisitioned cargo ships of 97,700 deadweight tons, and 56 ocean-going tugs.

Appropriations for substantially $1,900,000,000 (£390,000,000) have been made for the construction of contract ships, of which on March 1 there was an unspent balance of something over $500,000,000 (£102,500,000), an amount sufficient to carry the work into September, before which time it is hoped the new Congress will have provided additional funds. A total of $515,000,000 (£105,800,000) has also been authorized for requisitioned ships. As the appropriations from this fund so far made, totaling $415,000,000 (£85,300,000), have been practically exhausted, and as the last Congress failed to make additional appropriations asked for, the Emergency Fleet Corporation, under perfectly proper definitions, has transferred some of the vessels on the requisitioned account to the account of the contract ships. The funds provided for plant and housing construction and transportation are sufficient to carry out substantially the programme originally planned. It is apparent, therefore, that the shipyards of the country still have a very formidable programme of construction ahead of them, and that no fear need be entertained of an early cessation of work, if the next Congress will grant the necessary appropriations out of the amounts already authorized.

LETTER TO THE EDITOR

Credit Where Credit Is Due

The London *Engineer* in its issue of February 7, 1919, had the following editorial:

"Unofficial messages indicate that the *Constitution* class will be entirely redesigned, with all propelling machinery and boilers placed well below the waterline, a complete belt of armor, and a main battery of eight 16-inch guns. In other words, the essential features of the latest British battle cruisers are to be incorporated in the new American ships. It need hardly be said that this decision implies a handsome compliment to British naval architects and shipbuilders, whose prestige has never stood higher than it does to-day. Just as the *Majestics* of 1893 became the universally accepted model for battleship construction in every foreign country, so our present-day capital ships, cruisers, and even torpedo craft, are being duplicated more or less faithfully by all the leading naval powers. It is, perhaps, the finest tribute of all that the United States, which has hitherto endeavored to plan its fighting ships on original lines, should now be on the point of rejecting a purely American design in favor of one embodying what we are entitled to regard as typically British characteristics."

Whether the comments made by the editor of *The Engineer* are justified or not with relation to the battle cruisers recently designed for the United States Navy, I must take exception to the general remark that hitherto the United States has endeavored to plan its fighting ships on original lines and now is rejecting a purely American design in favor of a typically British design.

In the first place, the word "endeavored" has been used with a peculiarly unhappy inference; as much as to say that all endeavors of the United States Navy, where they departed from British practice, were failures.

Referring to the history of the design of war vessels, it may be well to point out to our English critic that the British battleship design has its foundation in the experience gained with the *Monitor* and *Merrimack* during the war of the rebellion in the 60's. Neither of these designs was British in any sense.

It would appear, therefore, that we must go back to designs worked out in the United States to find the prototype of the present British battleship. Coming down to more recent times and to one of the "endeavors" of the United States Navy, I would point out that when the present system of mounting heavy guns in turrets, one firing over the other, on the center line of the vessel was brought out by the United States, the British Admiralty criticised this disposition in the severest terms. At the present time, however, there is no navy in the world, including the British, but what has its major guns mounted in the American style. The British Navy, indeed, has gone so far as to adopt this inherent principle, in the mounting of the guns, on its latest torpedo-boat destroyers.

Another "endeavor" which I would refer to is that the present destroyers of the British Navy, in so far as the raised forecastle is concerned, is a direct take-over from the destroyers of the United States Navy built between the years of 1898 and 1915.

While willingly assenting to the great research and progress made in the design of war vessels by the British, and the large amount of pioneer work done by them, nevertheless our own modest contributions to the art of warship design should not be so summarily dismissed.

William A. Dobson, Naval Architect,
Wm. Cramp & Sons Ship & Engine Building Co.

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Shipping Board Contracts for Ships

Complete List of Vessels Contracted for or Requisitioned by the Shipping Board Up to January 31, 1919

STEEL SHIPS CONTRACTED, REQUISITIONED AND CONTRACTS PENDING

Company	Type	D. W. T. Per Ship	Contracted For, Requisitioned and Contracts Pending		Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
			No.	Tons	No.	Tons	No.	Tons	No.	Tons	No.	Tons
Recapitulation by Districts....												
North Atlantic	Cargo		287	1,920,730	34	262,825	34	221,900	74	540,798	145	895,207
Delaware River	"		159	1,357,502	54	399,257	14	106,300	34	308,995	57	542,950
Delaware River Agencies	"		240	1,925,000	4	30,000	14	111,000	61	480,500	161	1,303,500
Middle Atlantic	"		113	1,053,560	29	235,960	4	34,800	21	198,900	59	583,900
Southern	"		86	623,300	..	.....	2	7,000	22	169,300	62	447,000
Southern Pacific	"		235	2,147,000	53	495,000	27	249,150	46	416,050	109	986,800
Northern Pacific	"		307	2,609,994	110	910,394	21	171,600	45	387,400	131	1,140,600
Great Lakes	"		445	1,683,250	190	657,750	41	160,550	73	293,000	141	571,950
Country	"		1,872	13,320,336	474	2,991,186	157	1,062,300	376	2,794,943	865	6,471,907
Japan	"		45	374,670	15	128,820					30	245,850
China	"		4	40,000							4	40,000
Total			1 921	13,735,006	489	3,120,006	157	1,062,300	376	2,794,943	899	6,757,757
Tugs			112	A		....	9	....	28	....	75	A
Barges			10	31,000		....		....	1	7,500	9	23,500
Grand Total			2,043	13,766,006	489	3,120,006	166	1,062,300	405	2,802,443	983	6,781,257
Resume of All Steel Ships by Tonnage Classification....												
Under 5,000 D. W. Tons	Cargo		510	1,938,322	225	792,922	48	186,600	82	329,800	155	629,100
5,000 to 5,999 D. W. Tons	"		215	1,095,625	9	47,900	25	127,500	39	198,250	142	721,975
6,000 to 7,499 D. W. Tons	"		84	573,980	39	266,400	5	36,500	16	108,398	24	162,682
7,500 to 8,500 D. W. Tons	"		271	2,079,790	27	207,990	20	152,000	65	493,500	159	1,226,300
8,501 to 9,999 D. W. Tons	"		657	5 977 856	144	1,287,536	48	437,900	139	1,274,620	326	2,977,800
10,000 and over D. W. Tons	"		184	2,069,433	45	517,258	11	121,900	35	390,375	93	1,039,900
Total			1,921	13,735,006	489	3,120,006	157	1,062,300	376	2,794,943	899	6,757,757
Tugs no D. W. Tons			112	A			9	A	28	A	75	A
Barges 2,000 D. W. Tons			8	16,000							8	16,000
Barges 7,500 D. W. Tons			2	15,000					1	7,500	1	7,500
Total			122	31,000			9	A	29	7,500	84	23,500
Grand Total			2,043	13,766,006	489	3,120,006	166	1,062,300	405	2,802,443	983	6,781,257

A—Tug Boats no tonnage given.

STEEL TUGS CONTRACTED FOR AND CONTRACTS PENDING

District	Type	D. W. T. Per Ship	Contracted For and Contracts Pending		Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
			No.	Tons	No.	Tons	No.	Tons	No.	Tons	No.	Tons
North Atlantic	Ocean		66	A			6	A	15	A	45	A
Southern	Harbor		6	A					4	A	2	A
Great Lakes			40	A			3	A	9	A	28	A
Country	Ocean		104	A			9	A	24	A	71	A
	Harbor		8	A					4	A	4	A
Grand Total			112	A			9	A	28	A	75	A
Steel Barges Contracted for and Contracts Pending												
Southern			10	31,000					1	7,500	9	23,500
Concrete Ships Contract'd For												
North Atlantic	Cargo	3,500	1	3,500					1	3,500		
Middle Atlantic	Cargo	3,500	2	7,000					2	7,000		
Southern			6	40,500			1	3,000	4	30,000	1	7,500
Southern Pacific	Tanker		5	37,500					4	30,000	1	7,500
Grand Total			14	88,500			1	3,000	11	70,500	2	15 000

COMPOSITE SHIPS CONTRACTED FOR

District	Type	Design		Contracted For		Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
				Total No. Ships	Total Tonnage	No.	Tons	No.	Tons	No.	Tons	No.	Tons
Southern	Cargo	McClelland	3,500	24	84,000	6	21,000	7	24,500	11	38,500		
District No. 11	Cargo	Ballin	4 000	8	32,000	5	20,000	3	12,000				
Grand Total				32	116,000	11	41,000	10	36,500	11	38,500		

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WATERVLIET
P. Jesse Matton.
WEST NEW BRIGHTON
National Dry Dock & Repair Co., Inc.
YONKERS
Continental Shipbuilding Corp.

New Jersey

ATLANTIC CITY
Atlantic City Steamship & Terminal Co.
BAYONNE
The Elco Works.
Port Johnston Dry Dock Co.
CAMDEN
Camden Shipbuilding Co.
Dempsey & Sons.
Mathis Shipbuilding Co.
New York Shipbuilding Corporation.
Noecker & Ake Shipbuilding Co.
DORCHESTER
Shaw & Champion.
ELIZABETHPORT
Bethlehem Shipbld. Corp. (Moore Plant.
New Jersey Dry Dock & Transportation Co.
GLOUCESTER CITY
Pusey & Jones Company.
GREENWICH
Greenwich Piers Marine Railway Co.
HOBOKEN
W. & A. Fletcher Co.
Tietjen & Lang Dry Dock Co.
JERSEY CITY
Brown Dry Dock Co.
Barge & Lighter Repair Co., Inc.
Liberty Dry Dock & Repair Co.
Vulcan Iron Works, Inc.
KEARNEY
Federal Shipbuilding Co.
LITTLE FERRY
Ambursen Construction Company, Inc.
NEWARK
Submarine Boat Corp.
PERTH AMBOY.
Perth Amboy Dry Dock Co.
WEEHAWKEN
Union Dry Dock & Repair Co.
WESTVILLE
Westville Boat Building Co.

Pennsylvania

BETHLEHEM
Bethlehem Shipbuilding Corporation, Ltd.
BRISTOL
Merchant Shipbuilding Corp.
CHESTER
Chester Shipbuilding Company, Ltd.
Sun Shipbuilding Company.
CORNWELLS HEIGHTS
Traylor Shipbuilding Corp.
HARRIMAN
Merchant Shipbuilding Corporation.
HOG ISLAND
American International Shipbuilding Corp.
PHILADELPHIA
The William Cramp & Sons Ship & Engine Building Company.
Kensington Shipyard Dept. of Wm. Cramp & Sons. S. & E. B. Co.
The Philadelphia Ship Repair Company.
Southern Ship Building Company.

Delaware

BETHEL
Smith & Terry, Inc.
MILFORD
William G. Abbott Shipbuilding Co.
Vinyard Ship Building Co.
SEAFORD
Delaware Ship Building Co.
WILMINGTON
American Car & Foundry Co., Jackson & Sharp Plant.
Bethlehem Shipbuilding Corporation, Ltd., Harlan Plant.
The Pusey & Jones Co.

Maryland

ANNAPOLIS
The Chance Marine Construction Co.
BALTIMORE
The Baltimore Dry Docks & Ship Building Co.
Booz Brothers.
Chesapeake Marine Railway Co.
Coastwise Shipbuilding Co.
H. E. Crook Co., Inc.
McIntyre & Henderson.
Marine Engine & Boiler Co.
The Maryland Ship Building Co.
Nilson Yacht Building Co.
Redman-Vane Shipbuilding Co.
Chas. L. Rhode & Sons Co.
Henry Smith & Sons Co.
The Spedden Shipbuilding Co.
Union Shipbuilding Co.
Wm. E. Woodall & Co.
CAMBRIDGE
The Cambridge Mfg. Co.
Geo. T. Johnson & Sons.
CHESAPEAKE CITY
Southern Transportation Co., Shipyard Dept.
CRISFIELD
Crisfield Marine Railways.
ELKTON
E. Deibert & Co.
FAIRFIELD
Arundel Shipbuilding Co.
POCOMOKE CITY
E. James Tull.
SALISBURY
Wm. W. Smith.
Smith & Williams Co.
SOLOMONS
M. M. Davis & Son, Inc.
SPARROWS POINT
Bethlehem Shipbuilding Corp., Ltd., Maryland Shipbuilding Plant.

Virginia

ALEXANDRIA
Virginia Shipbuilding Corporation.
BATTERY PARK
Bloxom Bros. Corp.
FRANKLIN
The Sharpley Marine Railways.
HAMPTON
Hampton Shipbuilding & Dry Dock Corp.
Newcomb Lifeboat Co., Inc.
NEWPORT NEWS
Newport News Shipbuilding and Dry Dock Co.
NORFOLK
Colonna Marine Railway Corporation.
National Concrete Boat Co., Inc.
Norfolk Marine Railway Co., Inc.
Old Dominion Marine Railway Corp.
G. T. Taylor Marine Railway Corp.
W. E. Thomas & Co.
PORT RICHMOND
York River Shipbuilding Corp.
QUANTICO
Mo. Valley Bridge & Iron Co.
WEEMS
Humphreys Railway & Lumber Corp.
WEST POINT
C. H. Dunnmead & Son.
WILLIAMS WHARF
B. Williams & Co. & Matthews Marine Ry.

North Carolina

ELIZABETH CITY
Elizabeth City Ship Yard Co.
Maritime Engineering Corporation.
MOREHEAD CITY
North Carolina Ship Building Co.
Willis Marine Railways.
WASHINGTON
Beaufort County Iron Works, Inc.
WILMINGTON
Carolina Ship Building Corporation.
Liberty Shipbuilding Company.
Naul Shipbuilding Co.
Wilmington Iron Works—Wilmington Marine Railway Co.

South Carolina

CHARLESTON
Valk & Murdoch Co.

Georgia

BRUNSWICK
American Shipbuilding Company.
Brunswick Marine Construction Corps.
Brunswick Shipbuilding Co.
Oscar Daniels Company.
The Foundation Co.
United States Maritime Corporation.
DARIEN
Darien Shipbuilding Co.
SAVANNAH
Concrete Steel Ship Building Co.
The Foundation Co.
Georgia Shipbuilding Co.
Kehoe's Iron Works.
National Shipbuilding & Dry Dock Co.
Southland Steamship Co. (Shipbuilding Dept.)
Terry Shipbuilding Corporation.
Wilkinson Machine Co.

Florida

CARRABELLE
Dempsey-Camp Shipbuilding Co.
CLEVELAND
Cleveland Steam Marine Railroad.
JACKSONVILLE
Baxter Shipyard, Inc.
The A. Bentley & Sons Co.
Jacksonville Dry Dock & Repair Co.
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Gulf Shipbuilding Co.
MILTON
Bagdad Shipbu
PENSACOLA.
F. F. Bingham
The Bruce D
Pensacola Shi
Pensacola Ves
The Warren
SOUTH JACKSO
St. John's Riv
TAMPA
Oscar Daniels
Hillsboro Ship
Tampa Dock C
Tampa Shipbui
TARPON SPRIN
Anclote Shipb
E. Macrenaris

	Balance on Contract	
	No.	Tons
500	10	35,000
500	11	38,500
A		
000	19	66,500
	6	30,000
000	21	73,500
800	19	92,600
000	8	28,000
500		
M	4	19,200
400	4	16,400
000		
500	11	49,500
000		
000	16	56,000
700	138	536,700

MOBILE
Alabama Dry
Barret Shipbui
Chickasaw Shi
Concrete Ships
Fred T. Ley
Henderson Shi
Mobile Shipbu
Murman Shipb
Shell Bank Sh
BILOXI
Mississippi Sh
GULFPORT
Gulfport Ship
MOSS POINT
Dantzler Ship
Hodge Ship Co
PASCAGOULA
Dierks-Blodget
Gulf Ship Cor
International

L

MADISONVILLE
Jahncke Shipb
MORGAN
Union Bridge
NEW ORLEANS
Alabama & N Co.
Doullut & Wil
The Foundatio
Garland Yard Corp.
Jahncke Shipb
The Johnson L
Louisiana Shi
New Orleans
Star Ship Yar
SLIDELL
Louisiana Shi
WESTLAKE
Clooney Const

	Balance on Contracts	
	No.	Tons
500	11	49,500
500		
800	25	122,600
000	94	329,000
400		16,400
000		
500		
	4	19,200
000		
700	138	536,700

ARANSAS PASS
Macdonald En
BEAUMONT
Beaumont Shi
Lone Star Shi
McBride & La
J. N. McCann
GALVESTON
J. L. Bludwort
Galveston Dry
Mo. Valley Br
Seaboard Tran
LOUSTON
The Direct Na
Houston Ship
Midland Bridge
Universal Shi
ORANGE
International
National Ship
The Nat'l O
Southern Dry
ROCKPORT
Heldenfels Br

	Balance on Contracts	
	No.	Tons.
000	1	2,500
500		
500		
500		
350	3	13,650
150	4	16,150

MISSISS
CHARLESTON, W
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DUBUQUE, IOW
Dubuque Boat
GRAFTON, ILL.
Rippley Boat C
PADUCAH, KY.
Howard Shipy
PITTSBURGH, P
American Brid
The Dravo C
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Elizabeth Mari
Hazelwood Do
Pittsburgh Coa
James Rees &

	Balance on Contracts Number
	13
	45
	58

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ilding Co.

Dock Company.
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SVILLE
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Shipbuilding Corporation.

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COMPAN
Dock & Shipbuilding Co.
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RECAPITULATION BY D
building Co.
North Atlantic... ard, Emergency Fleet Corp.,
Delaware River... & Co., Inc.
Delaware River Ag ipbuilding Co., Inc.
Middle Atlantic.. ilding Company.
Southern..... uilding Corp.
Southern Pacific.. ipbuilding Co., Inc.
Northern Pacific..
Great Lakes.....

ississippi

COUNTRY..
ipbuilding Corp.
Japan.....
China..... Building Company.
TOTAL.... Building & Dry Docks Co.
mpany, Inc.
Tugs.....
Barges..... Shipbuilding Co.
pany.
GRAND TOTA ship Building Company.
RESUME OF ALL S
TONNAGE CLASS
Under 5,000 D. W
5,000 to 5,999 D.
6,000 to 7,499 D.
7,500 to 8,500 D
8,501 to 9,999 D.
10,000 and over D

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uilding Corp.
& Const. Co.
TOTAL.... ew Orleans Transportation
Tugs no D. W. T.
Barges 2,000 D. W
Barges 7,500 D. W
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n Co.
of International Navigation
TOTAL....
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GRAND TO ron Works, Ltd.
building Corp.
A—Tug Boat dry Dock & Ship Bldg. Co.
ds.
building Corp.
ruction & Towing Co.

Texas

DISTR
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North Atlantic... Building & Dry Dock Co.
pbuilding Co.
Southern..... w, General Contractors.
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Great Lakes....
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COUNTRY Dock and Construction Co.
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sportation & Shipping Co.
GRAND TO
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STEEL BARGES C Building Co.
AND CONTRACT e Co.
Southern..... building Company, Inc.
CONCRETE SHIPS Ship Building Corp.
North Atlantic.. Building Co. (Subsidiary of
l Co.)
Middle Atlantic. Dock & Ship Building Co.
Southern..... thers.
Southern Pacific.
GRAND TO

IPPI VALLEY

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& Boiler Works.
o.
rds & Dock Co.
DISTR
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ontracting Company, Engi-
ks Dept.
Southern..... ne Ways.
ck Co.
District No. 11. l Co.
Sons Co.
GRAND T

POINT PLEASANT, W. VA.
Enterprise Marine Dock Co.
Kanawha Dock Co.
Point Pleasant Dry Dock Co.
QUINCY, ILL.
Quincy Marine Ways.

GREAT LAKES

ASHTABULA, OHIO
Great Lakes Engineering Works.
BAY CITY, MICH.
James Davidson.
BENTON HARBOR, MICH.
Dachel-Carter Shipbuilding Co.
BUFFALO, N. Y.
Buffalo Dry Dock Co.
Buffalo Marine Construction Corporation.
Ferguson Steel & Iron Co.
The Lake Shipbuilding Co.
CHICAGO, ILL.
Chicago Shipbuilding Co.
Kraft Ship Yard & Dry Dock Co.
CLAYTON, N. Y.
Clayton Ship & Boat Building Corporation.
L. E. Fry & Co., Inc.
CLEVELAND, OHIO
Ohio Shipbuilding Co.
The American Ship Building Co.
The Great Lakes Towing Co.
DETROIT, MICH.
Detroit Shipbuilding Co.
Great Lakes Engineering Works.
Imperial Shipbuilding Corp'n.
DULUTH, MINN.
McDougall-Duluth Company.
Marine Iron & Shipbuilding Company.
ECORSE, MICH.
Great Lakes Engineering Works.
FERRYSBURG, MICH.
Johnston Bros.
GREEN BAY, WIS.
Northwest Engineering Works.
P. F. Thrall.
KEWAUNEE, WIS.
Wisconsin Shipbuilding & Navigation Corp.
LEVANNA, OHIO
Barrett Mill & Lumber Co.
LORAIN, OHIO
American Shipbuilding Co.
LUDINGTON, MICH.
Lunde Boat Bldg. Co.
MANISTEE, MICH.
Manistee Ship Bldg. Co.
MANITOWOC, WIS.
Burger Boat Company.
Manitowoc Shipbuilding Co.
MARINE CITY
Kenyon's Shipyard Company.
Sydney C. McLouth.
MILWAUKEE, WIS.
Fabricated Ship Corporation.
Great Lakes Boat Building Corporation.
Milwaukee Dry Dock Co.
MONTAGUE, MICH.
The Montague Iron Works.
MUSKEGON, MICH.
Peninsula Shipbuilding Corporation.
OGDENSBURG, N. Y.
The St. Lawrence Marine Railway.
OSWEGO, N. Y.
The Foundation Co.
J. H. & T. C. Goble.
PORT CLINTON, OHIO
The Matthews Company.
PORT HURON, MICH.
The Foundation Company.
Wolverine Dry Dock.
RACINE, WIS.
Racine Boat Company.
ROCHESTER, N. Y.
Rochester Boat Works, Inc.
ROCKY RIVER, OHIO.
The Rocky River Dry Dock Company.
SAULT STE. MARIE, MICH.
Heckler Bros.
SAGINAW, MICH.
Savinaw Shipbuilding Company.
STURGEON BAY, WIS.
Leatham & Smith Towing & Wrecking Co.
Universal Shipping Co.
SUPERIOR, WIS.
Globe Shipbuilding Company.
Superior Shipbuilding Co.
Whitney Brothers Company.
TOLEDO
The Toledo Shipbuilding Co.
WASHBURN, WIS.
Anchor Shipbuilding Co.
WEST DULUTH, MINN.
Marine Iron & Shipbuilding Works.

PACIFIC COAST

Alaska

JUNEAU
Alaska Dry Dock & Mfg. Co.

Washington

ABERDEEN
Gray's Harbor Motorship Corporation.
ANACORTES
Sloan Shipyard Corporation.
EVERETT
Pacific Coast Shipbuilding Co.
HADLOCK
Hadlock Shipbuilding Co.
HOUGHTON
Anderson Shipbuilding Corporation.
HOQUIAM
Matthews Shipbuilding Co.
OLYMPIA
Sloan Shipyards Corp.
RAYMOND
Sanderson & Porter.
SEATTLE
Allen Shipbuilding Company.
Ames Shipbuilding & Dry Dock Company.
J. F. Duthie & Co.
Elliott Bay Shipbuilding Co.
Inter-Ocean Barge & Transport Company.
McAteer Ship Bldg. Co.
Maritime Boat and Engine Works, Inc.
Meacham & Babcock Shipbuilding Co.
National Shipbuilding Co.
National Steel Construction Co.
Nilson & Kelez Shipbuilding Corporation.
Paterson-MacDonald Shipbuilding Co.
J. H. Price Shipbuilding Company.
Puget Sound Bridge & Dredging Co.
Seattle North Pacific Shipbuilding Co.
Skinner & Eddy Corporation.
Tregoning Boat Company.
West Waterway Boat Building Company.
Wilson Shipyards.
SOUTH BELLINGHAM
Pacific American Fisheries.
SOUTH BEND
South Bend Shipyard Co., Inc.
TACOMA
American Concrete Pipe & Shipbuilding Company.
The Foundation Co.
Seaborn Shipyards Company.
Tacoma Ship Building Co.
Todd Dry Dock and Construction Corp.
Wright Ship Yards.
VANCOUVER
Motorship Construction Co.
G. M. Standifer Construction Corp.
WINSLOW, WASH.
D. W. Hartzell, Inc.

Oregon

ASTORIA
McEachern Ship Co.
Geo. F. Rodgers & Company.
Wilson Shipbuilding Company.
COLUMBIA CITY
Sommarstrom Shipbuilding Co.
MARSHFIELD
Coos Bay Shipbuilding Company.
NORTH BEND
Kruse & Banks Shipbuilding Company.
NORTH PORTLAND
G. M. Standifer Construction Corp.
PORTLAND
Albina Engine & Machine Works, Inc.
Coast Ship Building Co.
Columbia Engineering Works.
Columbia River Ship Building Corp.
Grant Smith-Porter Ship Company.
The Foundation Co.
Kiernan & Kern.
Northwest Steel Co.
Peninsula Shipbuilding Company.
Supple-Ballin Shipbuilding Corp.
Willamette Shipbuilding Co.
ST. HELENS
St. Helens Shipbuilding Co.

California

BAY POINT, CONTRA COSTA COUNTY
Pacific Coast Shipbuilding Co.
BENICIA
Benicia Shipbuilding Corp.
EAST OAKLAND
Hanlon Dry Dock & Shipbuilding Co., Inc.
EUREKA
Hammond Lumber Company.
LONG BEACH
Long Beach Shipbuilding Co.
OAKLAND
Apex Manufacturing Co., Oakland, Emeryville, Cal.
Hanlon Dry Dock & Shipbuilding Co.
Moore Shipbuilding Company.
San Francisco Ship Building Co.
Union Construction Co.
PITTSBURGH
B. P. Lanteri.
SAN DIEGO
Pacific Marine and Construction Company.
San Diego Marine Construction Co.
San Diego Shipbuilding & Dry Dock Co.
SAN FRANCISCO
C. L. Arques.
Bowes & Andrews (Ship Repairing).
Main Iron Works.
Pacific Coast Shipbuilding Company.
Rolph Shipbuilding Company.
Union Iron Works Co.
Western Pipe & Steel Co. of California.
SAN PEDRO
Los Angeles Shipbuilding & Dry Dock Co.
Southwestern Shipbuilding Company.
SO. SAN FRANCISCO
Schaw Batcher Shipbuilding Co.
WILMINGTON
R. J. Chandler Shipbuilding Co.
Fulton Shipbuilding Company.
West Coast Shipbuilding Co.

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WOOD SHIPS CONTRACTED FOR AND CONTRACTS PENDING BY DISTRICTS AND DESIGNS

District	Design	Contracted For and Pending		†Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contract	
		Total No. Ships	Total Tonnage	No.	Tons	No.	Tons	No.	Tons	No.	Tons
North Atlantic	Ferris	91	318,500	16	56,000	30	105,000	35	122,500	10	35,000
	Continental	1	1,500					1	1,500		
Midd'e Atlantic	Ferris	32	112,000			4	14,000	17	59,500	11	38,500
Southern	Ferris	89	311,500	14	49,000	20	70,000	36	126,000	19	66,500
	Dougherty	6	30,000							6	30,000
Gulf	Ferris	78	273,000	2	7,000	21	73,500	34	119,000	21	73,500
	Dougherty	34	164,000	2	9,400	6	28,200	7	33,800	19	92,600
Southern Pacific	Ferris	43	150,500	4	14,000	11	38,500	20	70,000	8	28,000
	Hough	13	45,500	11	38,500	2	7,000				
Northern Pacific	Allen	1	3,650			1	3,650				
	Pac.-Amer.	7	24,500	1	3,500	3	10,500	3	10,500		
	Patt.-Mc-Donald	4	19,200							4	19,200
	Grays Harbor	27	108,800	7	28,000	10	40,000	6	24,400	4	16,400
	Ferris	105	367,500	23	80,500	31	108,500	43	147,000		
District No. 11	Ballin	20	90,000			2	9,000	7	31,500	11	49,500
	Hough	26	91,000	14	49,000	10	35,000	2	7,000		
	Peninsula	12	48,000	1	4,000	7	28,000	4	16,000		
	Ferris	38	308,000	14	49,000	30	105,000	28	98,000	16	56,000
Great Lakes	Lake & Ocean	1	2,500	1	2,500						
Grand Total		678	2,469,650	110	390,400	188	675,850	242	866,700	138	536,700

WOOD SHIPS CONTRACTED FOR AND CONTRACTS PENDING BY DESIGNS

	Design	Total No. Ships	Total Tonnage	Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
				No.	Tons	No.	Tons	No.	Tons	No.	Tons
	Allen	1	3,650			1	3,650				
	Ballin	20	90,000			2	9,000	7	31,500	11	49,500
	Continental	1	1,500					1	1,500		
	Dougherty	40	194,000	2	9,400	6	28,200	7	33,800	25	122,600
	Ferris	526	1,841,000	73	255,500	147	514,500	212	742,000	94	329,000
	Grays Harbor	27	108,800	7	28,000	10	40,000	6	24,400		16,400
	Hough	39	136,500	25	87,500	12	42,000	2	7,000		
	Lake & Ocean	1	2,500	1	2,500						
	Pac. Amer.	7	24,500	1	3,500	3	10,500	3	10,500		
	Patt.-Mc-Donald	4	19,200							4	19,200
	Peninsula	12	48,000	1	4,000	7	28,000	4	16,000		
Grand Total		678	2,469,650	110	390,400	188	675,850	242	866,700	138	536,700

WOOD BARGES CONTRACTED FOR AND PENDING

District	D. W. T. Per Ship	Contracted For and Pending		Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
		Total No. Ships	Total Tonnage	No.	Tons	No.	Tons	No.	Tons	No.	Tons.
North Atlantic		17	46,500					16	44,000	1	2,500
Middle Atlantic		7	17,500					7	17,500		
Southern		5	12,500					5	12,500		
Gulf		7	16,500					7	16,500		
Southern Pacific		1	3,500			1	3,500				
Northern Pacific		9	40,950			1	3,650	5	23,650	3	13,650
Grand Total		46	137,450			2	7,150	40	114,150	4	16,150

WOOD TUGS CONTRACTED FOR AND CONTRACTS PENDING

District	Design	Contracted For and Pending Number	Delivered Number	Being Fitted Out in Wet Basin Number	On Ways Number	Balance on Contracts Number
Entire Country	Ocean	46		13	20	13
	Harbor	94		6	43	45
Total		140		19	63	58

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Twin-Screw Troopship of 13,000 Tons D.W.

Three-Deck Combined Passenger and Cargo Vessel of 20,900 Tons Displacement on Draft of 31 Feet 9 Inches—Speed, 14 Knots

ONE of the most important classes of vessels authorized by the Shipping Board during the war was a fleet of twin-screw three-deck troopships designed to carry a total deadweight of 13,000 tons on a mean draft of 31 feet 9 inches. While in use as troopships, the vessels will have accommodations for about 2,700 troops, and, at the same time, will carry 7,000 tons deadweight. The designed speed is 14 knots, but reserve power is provided with the original intention of giving the ship, while in the war zone and lightened in draft, the necessary power to obtain a speed of 15 knots.

Although these vessels were originally designed as troopships, and are being constructed as such, they can readily be converted into combined passenger and cargo steamers for commercial service. Orders for seven of these vessels were placed with the New York Shipbuilding Corporation, Camden, N. J., by the Shipping Board.

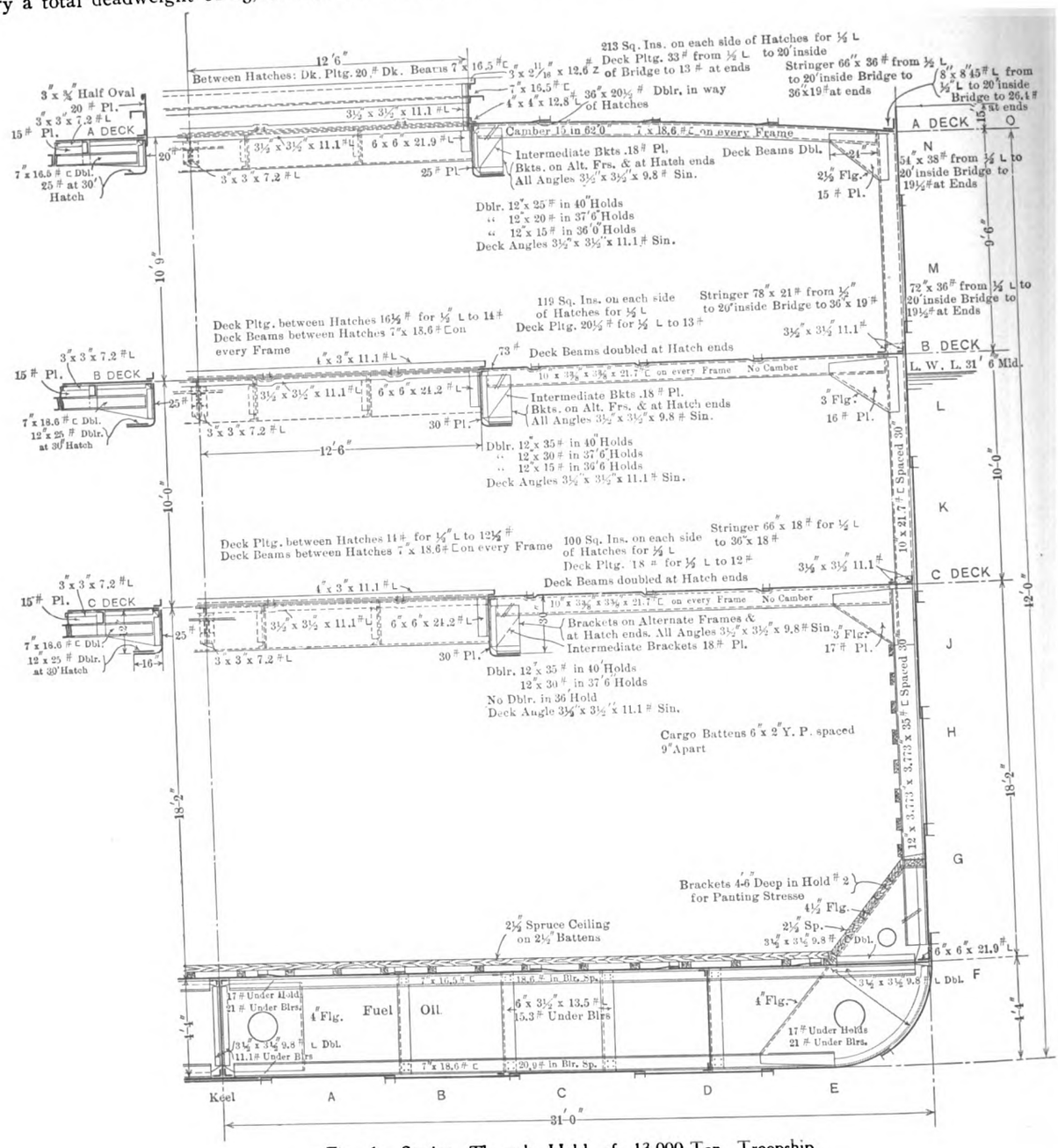
A DECK
B DECK
C DECK
Between Hatches: Dk. Pltg. 20 # Dk. Beams 7 x 16.5 # C
Camber 15 in 62'0"
Deck Beams Dbl.
Intermediate Bkts .18 # Pl.
Bkts. on Alt. Frs. & at Hatch ends
All Angles 3½" x 3½" x 9.8 # Sin.
Dblr. 12" x 25 # in 40" Holds
12" x 20 # in 37'6" Holds
12" x 15 # in 36'0" Holds
Deck Angles 3½" x 3½" x 11.1 # Sin.
Deck Pltg. between Hatches 16½ # for ½" L to 14 #
Deck Beams between Hatches 7" x 18.6 # C on every Frame
119 Sq. Ins. on each side of Hatches for ½ L
Deck Pltg. 20½ # for ½ L to 13 #
Deck Beams doubled at Hatch ends
Dblr. 12" x 35 # in 40" Holds
12" x 30 # in 37'6 Holds
12" x 15 # in 36'6 Holds
Deck Pltg. between Hatches 14 # for ½" L to 12½ #
Deck Beams between Hatches 7" x 18.6 # C on every Frame
100 Sq. Ins. on each side of Hatches for ½ L
Deck Pltg. 18 # for ½ L to 12 #
Brackets on Alternate Frames & at Hatch ends. All Angles 3½" x 3½" x 9.8 # Sin.
Intermediate Brackets 18 # Pl.
Dblr. 12" x 35 # in 40" Holds
12" x 30 # in 37'6 Holds
No Dblr. in 36' Hold
Deck Angle 3½" x 3½" x 11.1 # Sin.
Cargo Battens 6" x 2" Y. P. spaced 9" Apart
2½" Spruce Ceiling on 2½" Battens
Fuel
Oil
Keel
A
B
C
D
E
31'0"

Fig. 1.—Section Through Hold of 13,000-Ton Troopship

Although these vessels were originally designed as troopships, and are being constructed as such, they can readily be converted into combined passenger and cargo steamers for commercial service. Orders for seven of these vessels were placed with the New York Shipbuilding Corporation, Camden, N. J., by the Shipping Board.

The principal dimensions are as follows:

Length overall	522 feet 6 inches
Length per classification rules	502 feet
Beam, molded	62 feet
Depth to *A* deck	42 feet
Depth to *B* deck	32 feet 8 inches

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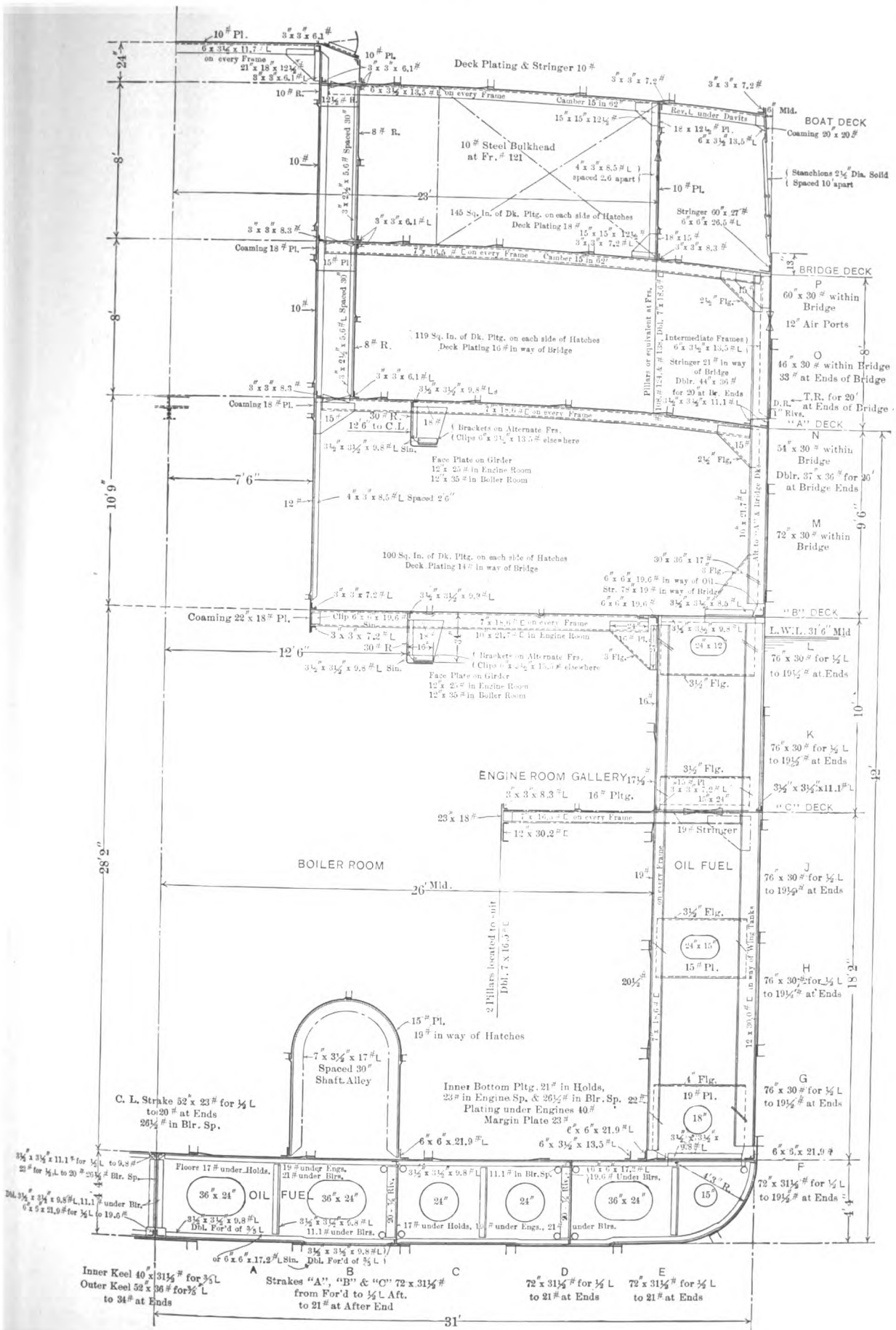
Deck Plating & Stringer 10 #
BOAT DECK
BRIDGE DECK
"A" DECK
"B" DECK
"C" DECK
10 # Steel Bulkhead at Fr. # 121
Coaming 18 # Pl.
Coaming 22" x 18 # Pl.
Face Plate on Girder 12" x 25 # in Engine Room 12" x 35 # in Boiler Room
ENGINE ROOM GALLERY
BOILER ROOM
OIL FUEL
Inner Bottom Pltg. 21 # in Holds, 23 # in Engine Sp. & 26½ # in Blr. Sp.
Plating under Engines 40 #
Margin Plate 23 #
C. L. Strake 52" x 23 # for ½ L to 20 # at Ends 26½ # in Blr. Sp.
Inner Keel 40" x 31⅛ # for ⅜ L
Outer Keel 52" x 36 # for ⅜ L to 34 # at Ends
Strakes "A", "B" & "C" 72" x 31⅛ # from For'd to ½ L Aft. to 21 # at After End
72" x 31⅛ # for ½ L to 21 # at Ends
72" x 31⅛ # for ½ L to 21 # at Ends
Shaft Alley
Floors 17 # under Holds.
OIL
FUEL
31
A
B
C
D
E
F
G
H
J
K
L
M
N
O
P

Fig. 3.—Midship Section of 13,000-Ton Troopship

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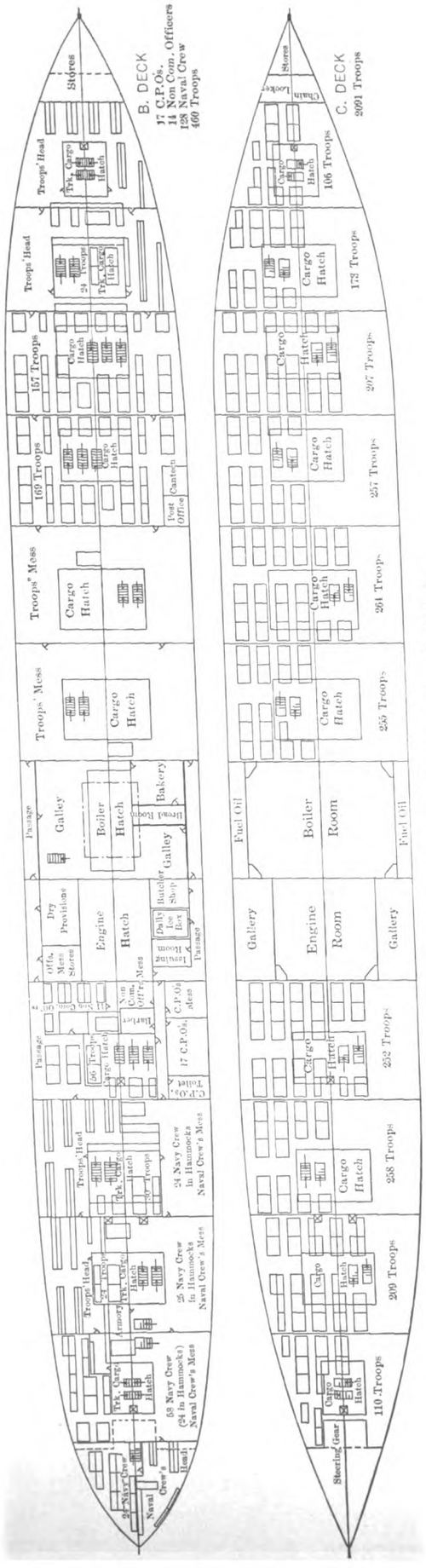

Fig. 4.—General Arrangement Plans of *B* and *C* Decks

Designed draft, full load	31 feet 9 inches
Corresponding displacement, about	20,900 tons
Corresponding deadweight capacity, about	13,000 tons
Indicated horsepower	7,000
Speed on trial	14½ knots
Trial draft	24 feet
Total cubic capacity, about	655,000 cubic feet
Deadweight capacity as a trooper (on trial)	7,000 tons
Number of passengers (troops)	2,700

The hull is designed with a straight stem and cruiser stern with three complete steel decks, designated as *A*, *B* and *C* decks, with steel deckhouses amidships and a short poop and forecastle and a long bridge.

General Arrangement

The tops of the deckhouses are carried out to the sides of the vessel to form a boat deck which is of steel unsheathed. A wooden wheel house and chart room are placed forward on the boat deck, and a similar house for winches aft. A flying bridge is placed at the level of these structures at each end of the superstructure.

A double bottom extends from the forward peak to the after end of No. 8 hold and is divided by transverse members into ten main compartments on each side. The compartments under the engine room are arranged to carry feed water only, while all other compartments are arranged for carrying either fuel oil or water ballast.

Above the tank top the hull is subdivided by thirteen transverse watertight bulkheads, all of which extend up to *A* deck, giving six cargo holds forward and four aft of the machinery space. Separate compartments are provided for the engines and boilers. Wing bulkheads, extending up to *B* deck, are fitted in the boiler room to form side tanks for fuel oil.

All accommodations for officers are provided above decks. The *B* and *C* decks are used for accommodating about 2,500 troops, in addition to the naval crew.

Each of the regular cargo holds is reached through large hatches in all of the decks. Each hatch is served by two cargo booms located at derrick posts, each boom being served by a single-drum single-geared winch.

As a troop transport the vessel is subdivided for a three-compartment ship with 30 percent permeability for the cargo and troop spaces and engine and boiler spaces, this condition to obtain with the vessel carrying 7,000 tons total deadweight.

Hull Construction

The hull is built with transverse framing, the frames being spaced 30 inches center to center amidships and reduced at the ends. There is no sheer amidships, but at the ends the sheer is quite pronounced. The *B* and *C* decks have no camber, while all weather decks have a camber of 15 inches in 62 feet.

Above the tank top the frames are channel section except in the peaks and in way of excessive bevel, where they are built up of angles and reverse angles. Solid floors are fitted on every third frame with angle frames and reverse frames. Double frames or their equivalent are fitted on every floor from three-fifths length forward to the collision bulkhead.

The center keelson is continuous throughout the length of the ship. Two longitudinals are fitted on each side of the center keelson, intercostal between solid floors with the thickness increased under the boilers.

No web frames are fitted in the cargo holds. The staying and stiffening of the fuel oil bunkers in the boiler space render the fitting of web frames in these spaces unnecessary. Two web frames are fitted in the engine room and webs are also fitted as panting frames at the

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ends. No side stringers are fitted amidships, but short stringers are fitted at the ends to resist panting.

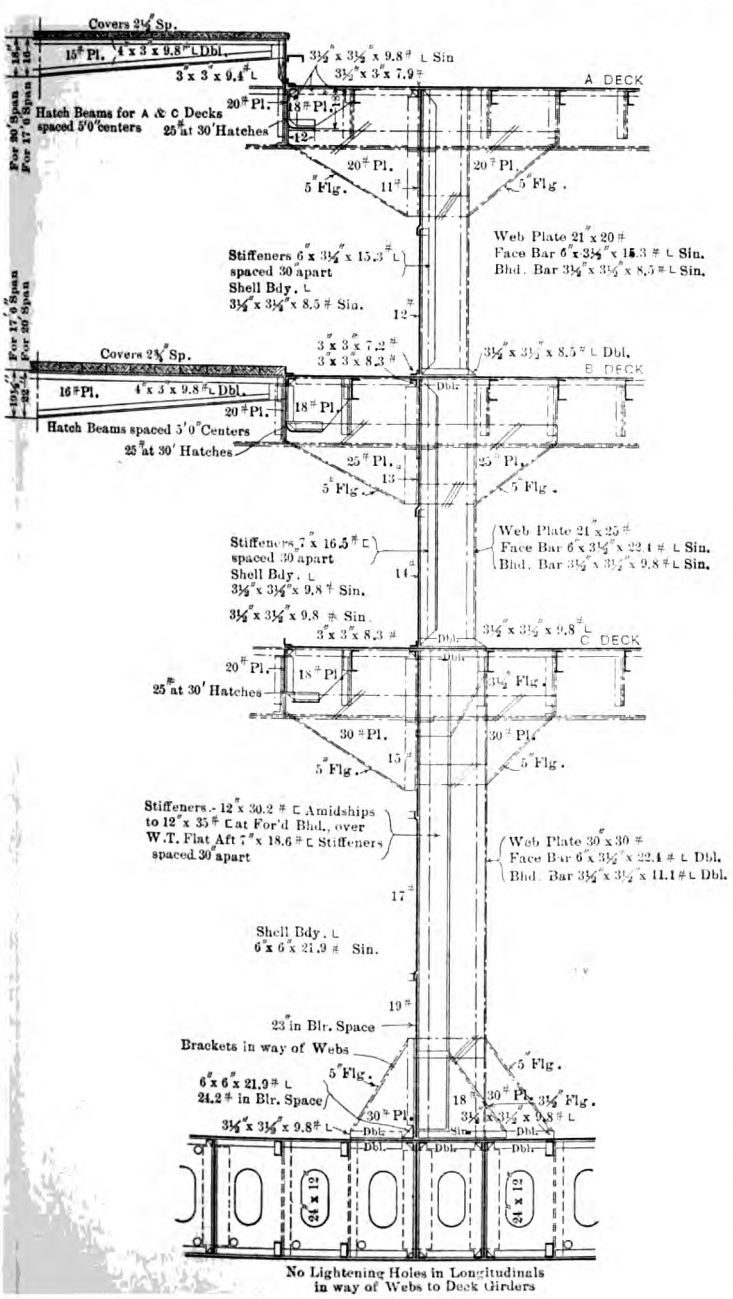
All of the decks are steel plated, riveted to channels on every frame. On *B* and *C* decks the deck beams are joggled down with the plating worked flush. The deck beams stop at the inner face of the frames.

The cargo holds are free from pillars, strength being provided by girders well supported at the bulkheads. Pillars are fitted only at the ends of the ship and locally.

The steam windlass, of the spur-geared type, triple-geared, is located under the forecastle with the engine on the same bed. There are twenty cargo winches, sixteen of which are 8¼ inches by 8 inches, double-cylinder, single-drum, single-geared reversible winches with one winch head on each winch, and four others, two forward and two aft, of the double-geared single-drum type, each with two large winch heads. In connection with the steam heating system, a system of mechanical ventilation is fitted for the troop spaces. Steam coils are placed in the discharge ducts of the mechanical ventilating system, which is operated by electrically driven fans.

Electricity is furnished by three 50-kilowatt turbo generating sets, and an auxiliary lighting circuit, operated by a 25-volt storage battery, is provided on the boat deck for the illumination of lifeboats and handling gear.

The refrigerating plant, of the brine circulating system, consists of two main machines, each of about 10 tons capacity. Each machine is self-contained and includes the compressor engine and all necessary apparatus.


Covers 2½" Sp.
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3" x 3" x 9.4# L
3½" x 3½" x 9.8# L Sin
3½" x 3" x 7.9#
A DECK
Hatch Beams for A & C Decks spaced 5'0" centers
25" at 30' Hatches
20# Pl.
18# Pl.
12"
5" Flg.
11"
Web Plate 21" x 20#
Face Bar 6" x 3½" x 15.3# L Sin.
Bhd. Bar 3½" x 3½" x 8.5# L Sin.
Stiffeners 6" x 3½" x 15.3# L spaced 30" apart
Shell Bdy. L 3½" x 3½" x 8.5# Sin.
12#
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B DECK
Covers 2½" Sp.
16# Pl.
4" x 3" x 9.8# L Dbl.
Hatch Beams spaced 5'0" Centers
25" at 30' Hatches
25# Pl.
13"
Web Plate 21" x 25#
Face Bar 6" x 3½" x 22.4# L Sin.
Bhd. Bar 3½" x 3½" x 9.8# L Sin.
Stiffeners 7" x 16.5# C spaced 30" apart
Shell Bdy. L 3½" x 3½" x 9.8# Sin.
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3½" x 3½" x 9.8# Sin.
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Web Plate 30" x 30#
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Bhd. Bar 3½" x 3½" x 11.1# L Dbl.
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Shell Bdy. L 6" x 6" x 21.9# Sin.
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23" in Blr. Space
Brackets in way of Webs
6" x 6" x 21.9# L 24.2# in Blr. Space
3½" x 3½" x 9.8# L
24 x 12
No Lightening Holes in Longitudinals in way of Webs to Deck Girders

Fig. 5.—Details of Bulkhead Construction

Propelling Machinery

Propulsion is by two sets of four-cylinder triple-expansion reciprocating engines with cylinders 24 inches, 40½ inches, 54 inches and 54 inches diameter by 45 inches stroke, supplied with steam at 220 pounds pressure by six single-end Scotch boilers, 15 feet 3 inches mean diameter and 11 feet 6 inches long between heads, giving a total heating surface of about 16,000 square feet.

The engine cylinders are mounted on four front and four back cast iron housings of box section. The fore-and-aft arrangement of the cylinders is low pressure, high pressure, intermediate pressure, low pressure. Only the high-pressure cylinder is fitted with a liner. The high-pressure and intermediate-pressure cylinders each have one piston valve, while each of the low-pressure cylinders has one double-ported flat slide valve. The intermediate- and low-pressure valves are provided with Lovekin assistant cylinders.

Propellers

The propellers are three-bladed of the built-up type, about 16 feet 6 inches diameter. The propeller shafts are 15¾ inches diameter and the line shafting 13⅞ inches diameter.

There are two main condensers, each independent and containing 4,500 square feet of cooling surface. There are also two centrifugal main circulating pumps with 16-inch suction and discharge connections: each of the pumps has a capacity of 5,000 gallons per minute against a 25-foot head. The pumps are driven by single-cylinder reciprocating engines 10 inches diameter by 10 inches stroke. There are also two main air pumps of the vertical twin-beam single-acting type with one steam cylinder and two air cylinders, 14 inches and 28 inches by 18 inches.

Auxiliaries

The engine room auxiliaries include a feed water heater with a capacity for heating 125,000 pounds of water per hour from 90 degrees to 212 degrees F. with exhaust steam at 5 pounds gage; a feed and filter tank of 1,400 gallons capacity; two injectors of the double-tube type with 2-inch suction and discharge; two evaporators, each with a capacity of 25 tons per twenty-four hours, and two distillers, each to produce 3,000 gallons of potable water in twenty-four hours. There is also an auxiliary condenser with a cooling surface of 1,000 square feet.

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The engine room auxiliary equipment includes the following pumps:

PUMPS

Two vertical simplex main feed, 14 inches and 10 inches by 24 inches.
One vertical simplex auxiliary feed, 10 inches and 7 inches by 24 inches.
One horizontal duplex ballast, 10 inches and 12 inches by 12 inches.
One horizontal duplex, fire and bilge and general service, 12 inches and 8½ inches by 12 inches.
One horizontal duplex sanitary, 7½ inches and 9 inches by 10 inches.
One vertical simplex engine room bilge, 6 inches and 7 inches by 12 inches.
Two horizontal duplex fresh water, 7½ inches and 6 inches by 10 inches.
One horizontal duplex drinking water, 4½ inches and 3¾ inches by 4 inches.
One horizontal duplex evaporator feed, 7½ inches and 6 inches by 10 inches.
One horizontal simplex combined air and circulating, 10 inches and 12 inches and 14 inches by 12 inches.
One vertical duplex oil transfer, 7½ inches and 9 inches by 10 inches.
Two vertical duplex oil service, 7½ inches and 4½ inches by 10 inches.
One horizontal duplex ice machine condenser circulating, 6 inches and 5¾ inches by 6 inches.
Two horizontal duplex brine circulating, 6 inches and 5¾ inches by 6 inches.

The boiler room auxiliaries, in addition to the apparatus in connection with the mechanical atomizing oil burners, include two forced draft fans direct connected to single cylinder vertical engines each capable of delivering 28,000 cubic feet of air per minute against a static pressure of 3 inches of water.

Oil Tank Steamer of 10,100 Tons D. W.

Type of Vessel Authorized by the Shipping Board— Cargo Space Divided Up Into 18 Main and 8 Summer Tanks

AS a part of the fleet of oil tankers ordered by the United States Shipping Board Emergency Fleet Corporation during the war, the Sparrows Point (Maryland) plant of the Bethlehem Shipbuilding Corporation is building ten single-screw tankers of 10,100 tons deadweight capacity each. In these vessels the machinery is located aft and the pump room forward. There are duplicate electric light sets, and all the auxiliary machinery usually fitted on oil tankers. The dimensions of the vessels are as follows:

Length between perpendiculars	435 feet
Beam, molded	56 feet
Depth, molded to upper deck	33 feet 6 inches
Height between decks	7 feet 6 inches
Block coefficient	0.775
Draft, loaded	26 feet
Deadweight capacity at above draft	10,100 tons
Number of main oil tanks	18
Number of summer tanks	8
Total capacity main tanks for fuel oil	10,140 tons

CAPACITIES OF OIL TANKS

	Tons
Main fuel tank	844
Main fuel wings	75
Deep tank forward	820
Total fuel oil	11,879
Refined oil, summer tanks	899
Refined oil, main cargo tanks	8,241
Total refined oil	9,140

The hull is built on the Isherwood system of longitudinal framing, with a straight stem and elliptical stern with a poop deck, a bridge house amidships and full topgallant forecastle forward.

HULL CONSTRUCTION

The engine and boiler spaces are of such dimensions and so arranged as to gain a 32 percent deduction for tonnage. Intermediate athwartship bulkheads are fitted, dividing the petroleum cargo spaces into nine compartments, extending from the keel to the top of the expansion trunk. A longitudinal oiltight bulkhead is fitted in the petroleum and fuel compartments and carried through the cofferdam and forward ballast tanks to the collision bulkhead. At the forward end it is extended through the pump room.

The summer tanks are emptied and filled through two 6-inch lines led to the main pumps.

A double bottom, built on the cellular system, is fitted under the engine and boiler room spaces. These tanks are used for fresh water and the fore and after peak tanks for ballast. The forward deep tank may be used for either ballast or fuel oil. The tank under the machinery space is divided fore and aft and athwartships into four tanks for convenience in trimming the vessel.

In all, the hull is subdivided by sixteen bulkheads, including the screen between the engine and boiler rooms, fourteen of which are oiltight and one watertight. The stringers in the holds are stopped at the bulkheads and connected with gussets.

CARGO OIL PIPING SYSTEM

The cargo oil piping system consists of two 16-inch by 14-inch by 24-inch horizontal duplex pumps installed in the pump room. The suction system consists of a 10-inch main on each side of the centerline connecting with the main tanks only. Each main cargo tank has one 8-inch suction. The pumps are so arranged that either separately or together they may discharge into a single 12-inch discharge main running along the upper deck. Two connections, 8 inches diameter, are made from the deck discharge main to the main suction line on each side of the ship for filling or discharging back to each tank through the main suction. There are two 10-inch discharge branches, one forward and one aft, fitted to the main discharge line of the ship. A 10-inch discharge branch is fitted to the main discharge line on each side of the ship amidships. An 8-inch discharge line is extended to the after end of the poop deck.

The deck machinery includes windlass, capstan and winches of the Bethlehem-Moore plant make. Electricity is furnished by two 15-kilowatt sets.

PROPELLING MACHINERY

Propulsion is by a single four-bladed built-up propeller, 18 feet diameter, driven by a triple-expansion engine with cylinders 27 inches, 47 inches and 78 inches diameter by 48 inches stroke, supplied with steam at 220 pounds pres-

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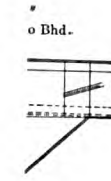

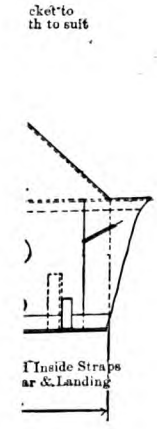

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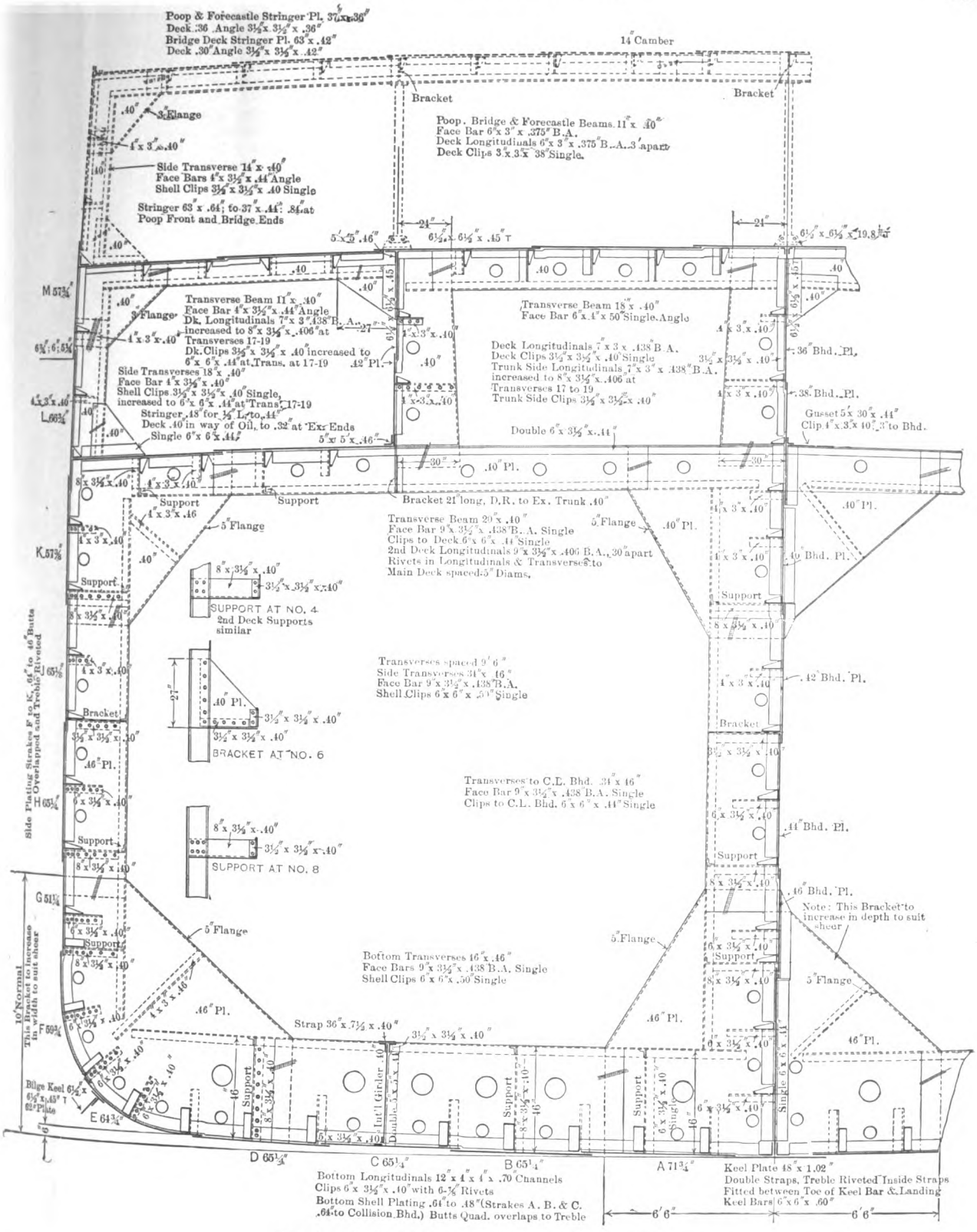
Poop & Forecastle Stringer Pl. 37"x.36"
Deck .36" Angle 3½"x 3½"x .36"
Bridge Deck Stringer Pl. 63"x.42"
Deck .30" Angle 3½"x 3½"x .42"
14" Camber
Bracket
Bracket
Poop, Bridge & Forecastle Beams 11"x .40"
Face Bar 6"x 3"x .375" B.A.
Deck Longitudinals 6"x 3"x .375" B.A. 3' apart
Deck Clips 3"x 3"x .38" Single
3" Flange
Side Transverse 14"x .40"
Face Bars 4"x 3½"x .44" Angle
Shell Clips 3½"x 3½"x .40" Single
Stringer 63"x .64" to 37"x .44" .84" at
Poop Front and Bridge Ends
Transverse Beam 11"x .40"
Face Bar 4"x 3½"x .44" Angle
Dk. Longitudinals 7"x 3"x .438" B. A.,
increased to 8"x 3½"x .406" at
Transverses 17-19
Dk. Clips 3½"x 3½"x .40" increased to
6"x 6"x .44" at Trans. at 17-19
Side Transverses 18"x .40"
Face Bar 4"x 3½"x .40"
Shell Clips 3½"x 3½"x .40" Single,
increased to 6"x 6"x .44" at Trans. 17-19
Stringer .48" for ½" L to .44"
Deck .40 in way of Oil, to .32" at Ex. Ends
Single 6"x 6"x .44"
Transverse Beam 18"x .40"
Face Bar 6"x .4"x 50" Single Angle
Deck Longitudinals 7"x 3"x .438" B.A.
Deck Clips 3½"x 3½"x .40" Single
Trunk Side Longitudinals 7"x 3"x .438" B.A.
increased to 8"x 3½"x .406" at
Transverses 17 to 19
Trunk Side Clips 3½"x 3½"x .40"
Double 6"x 3½"x .44"
Bracket 21" long, D.R. to Ex. Trunk .40"
Transverse Beam 20"x .40"
Face Bar 9"x 3½"x .438" B. A. Single
Clips to Deck 6"x 6"x .44" Single
2nd Deck Longitudinals 9"x 3½"x .406 B.A., 30" apart
Rivets in Longitudinals & Transverses to
Main Deck spaced 5" Diams.
SUPPORT AT NO. 4
2nd Deck Supports
similar
Transverses spaced 9' 6"
Side Transverses 34"x .46"
Face Bar 9"x 3½"x .438" B.A.
Shell Clips 6"x 6"x .50" Single
BRACKET AT NO. 6
Transverses to C.D. Bhd. 34"x 46"
Face Bar 9"x 3½"x .438" B.A. Single
Clips to C.L. Bhd. 6"x 6"x .44" Single
SUPPORT AT NO. 8
Bottom Transverses 46"x .46"
Face Bars 9"x 3½"x .438" B.A. Single
Shell Clips 6"x 6"x .50" Single
Strap 36"x 7½"x .40"
Bottom Longitudinals 12"x 4"x 4"x .70" Channels
Clips 6"x 3½"x .40" with 6-⅞" Rivets
Bottom Shell Plating .64" to .48" (Strakes A. B. & C.
.64" to Collision Bhd.) Butts Quad. overlaps to Treble
Keel Plate 48"x 1.02"
Double Straps, Treble Riveted Inside Straps
Fitted between Toe of Keel Bar & Landing
Keel Bars 6"x 6"x .60"
Side Plating Strakes F to K, .64" to .46" Butts
Overlapped and Treble Riveted
10" Normal
This Bracket to Increase
in width to suit sheer
Bilge Keel 6½"x
6½"x .43" T
62" Plate
Int'l Girder .40"
Double 5"x 3½"x .40"
Single 6"x 6"x .44"
.36" Bhd. Pl.
.38" Bhd. Pl.
Gusset 5"x 30"x .44"
Clip 4"x 3"x 10" .3" to Bhd.
.40" Bhd. Pl.
.42" Bhd. Pl.
.44" Bhd. Pl.
.46" Bhd. Pl.
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F 59¾"
E 64¾"
D 65½"
C 65¼"
B 65¼"
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Fig. 2.—Midship Section of 10,100-Ton Oil Tanker

sure by three single-end Scotch boilers 15 feet inside diameter and 11 feet 9 inches long, with a total heating surface of 8,265 square feet. The main condenser has a cooling surface of 4,000 square feet and is designed to produce a vacuum of 26½ inches when running in water at a temperature of 70 degrees F. at sea. An auxiliary condenser is provided with a cooling surface of 600 square feet.

The engine room auxiliaries include the following:

Centrifugal circulating pump with 15-inch suction and 14-inch discharge, diameter of impeller 45 inches.

One feed and filter tank.

One feed water heater designed to raise the feed water from a temperature of 100 degrees to 210 degrees F. at the rate of 55,000 pounds per hour with exhaust steam at 10 pounds pressure.

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One evaporator with a capacity of 20 tons in 24 hours.

One distiller with a capacity of 2,000 gallons per twenty-four hours.

One 2-inch diameter injector.

One Edwards air pump, 26 inches diameter by 24 inches stroke, driven off the low-pressure crosshead of the main engine.

Two main bilge and two hot well pumps, each 4½ inches by 24 inches, driven off the low-pressure crosshead.

PUMPS

Two vertical simplex feed pumps, 12 inches and 7 inches by 18 inches.

One horizontal duplex fire and general service pump, 12 inches and 8¼ inches by 12 inches.

One horizontal duplex bilge pump, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex sanitary pump, 7 inches and 6 inches by 10 inches.

One horizontal duplex fresh water pump, 4 inches and 3¾ inches by 5 inches.

One horizontal duplex evaporator feed pump, 3 inches and 3 inches by 4 inches.

One horizontal duplex bilge pump (in pump room), 6 inches and 5¾ inches by 6 inches.

One horizontal duplex ballast and fuel oil transfer pump (forward), 7 inches and 6 inches by 10 inches.

Two horizontal duplex fuel oil pumps, 6 inches and 4 inches by 6 inches.

Two horizontal duplex cargo pumps, 16 inches and 14 inches by 24 inches.

There is also a refrigerator plant consisting of a 2-ton ammonia ice machine with a capacity for making 200 pounds of ice daily. The fuel oil-burning system is of the Union Iron Works type.

Standard 7,500-Ton Oil Tanker

Single-Screw Vessel Designed for 11 Knots Sea Speed—Type of Propelling Machinery Optional

ONE of the designs adopted by the United States Shipping Board Emergency Fleet Corporation as a standard for the construction of oil tank steamers calls for a vessel of 7,500 tons deadweight built on the Isherwood system of longitudinal framing with two continuous steel decks from stem to stern and a raised forecastle, bridge and poop. The dimensions of the vessel are:

Length overall	405 feet
Length between perpendiculars	392 feet
Beam, extreme	51 feet 4 inches
Depth, molded to upper deck	30 feet 2 inches
Depth, molded to main deck	22 feet 8 inches
Mean draft	24 feet 3 inches
Block coefficient	0.79

The hull is divided by oiltight and watertight transverse bulkheads and a centerline oiltight bulkhead into compartments forming fourteen main oil tanks and six summer tanks; two fuel oil tanks; a cargo hold forward; a pump room amidships, and machinery space aft.

The vessel is designed for a mean draft not to exceed 24 feet 3 inches, with a drag aft of about 11 inches under the following conditions: Vessel complete ready for sea, steam up and fully loaded (5,450 tons), 1,526,000 gallons of oil weighing 8 pounds per gallon, 1,315 tons of dry cargo, 590 tons of fuel oil, 120 tons of feed water under the boiler space, 25 tons of drinking water, and all outfit, crew, supplies, etc., aboard.

The electric light plant consists of two 10-kilowatt, General Electric, 110-volt, turbo-driven generator sets. The deck machinery includes a 12-inch by 12-inch windlass, an 8-inch by 8-inch capstan and a steam steering gear operated by a Brown telemotor.

The cargo piping consists of a 10-inch line running fore and aft along each side of the longitudinal centerline bulkhead.

Propulsion is by a triple-expansion engine with cylinders 27 inches, 45 inches and 75 inches diameter by 48 inches stroke, designed to give the vessel a speed of 11 knots under load conditions at a 24-foot mean draft with the engine turning at 80 revolutions per minute. Steam is supplied at a working pressure of 190 pounds per square inch by three single-end oil-burning Scotch boilers, 14 feet 8 inches inside diameter and 11 feet long, with a total heating surface of 7,128 square feet.

In place of the reciprocating engine and Scotch boilers, a geared turbine unit of 2,500 shaft horsepower, designed to drive the propeller at a normal speed of 90 revolutions per minute, and oil-fired watertube boilers with a total heating surface of about 9,000 square feet, may be installed.

How the Union Shipbuilding Company Met a War Emergency

BY FRANK G. REINHARDT, JR.

DURING the war emergency the shipyards were compelled to extend every possible effort to accomplish the programme laid out for them by the Emergency Fleet Corporation. As the drafting department is one of the most important departments in the shipbuilding industry, the Union Shipbuilding Company, Baltimore, Md., established a course in naval architecture to meet the increasing demand of ship draftsmen. The course was inaugurated by H. A. Everett, the naval architect of the company, who appointed efficient teachers to take care of the studies involved. The class was open to men from the mold loft, draftsmen experienced along other lines who had switched over to the shipbuilding industry, and apprentice draftsmen. The only qualifications necessary were to have reached a certain stage in mathematics and to have a fair experience in the use of drafting tools.

Two distinct courses of study were adopted—one in practical shipbuilding, and the other in theoretical naval architecture. The former course consists only of the practical work of construction, from the making of the raw material to the equipped vessel, including subsequent upkeep and repairs. "Practical Shipbuilding," by A. Campbell Holms, surveyor of Lloyd's Register of Shipping, was adopted as the text-book in this course. The other course of study deals with just the reverse of the former, i.e., the theory involved in ship construction. Attwood's "Text Book of Theoretical Naval Architecture" is used as the text in this course.

The method of procedure in the classroom in these

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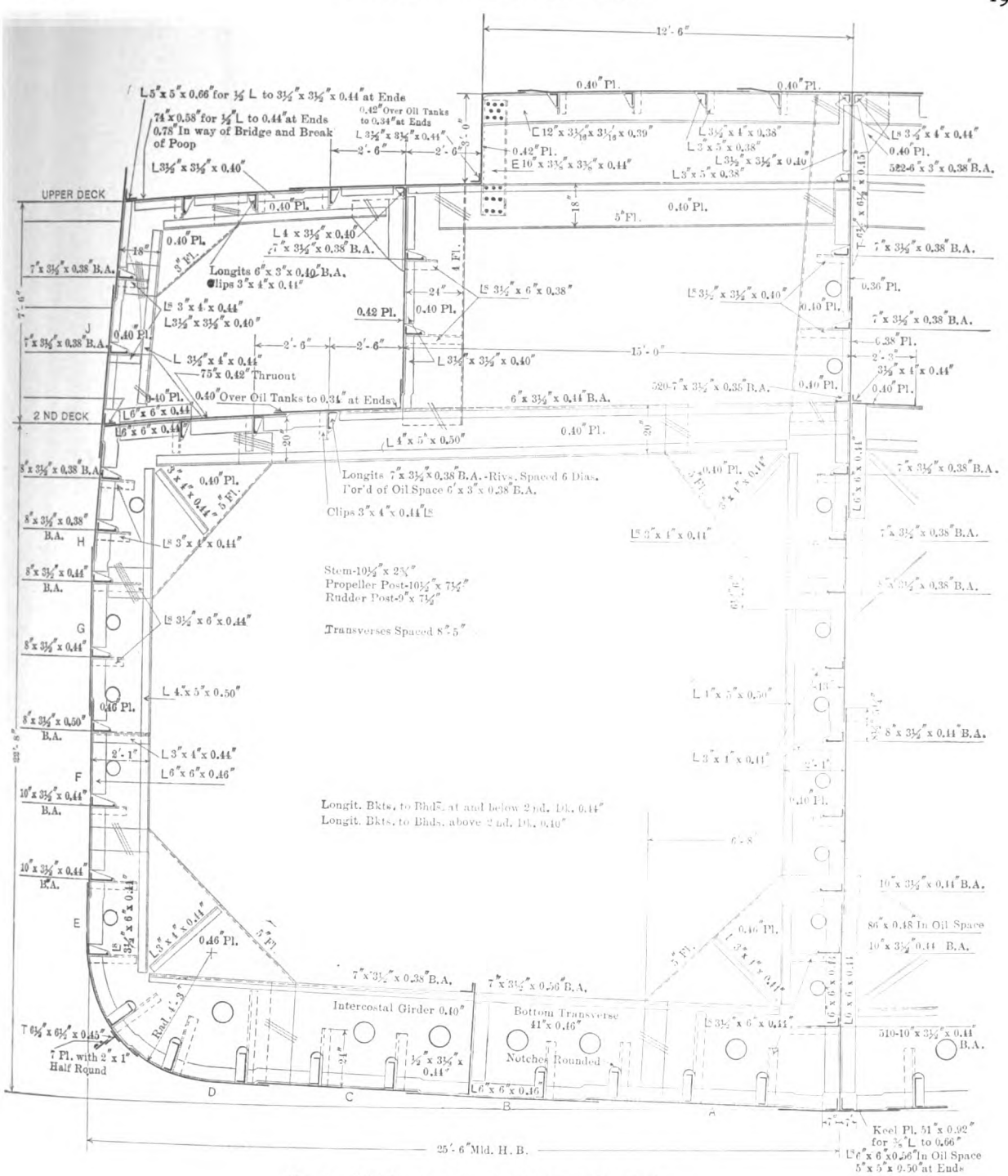
12'-6"
UPPER DECK
2 ND DECK
Longits 6"x 3"x 0.40" B.A.
Clips 3"x 4"x 0.44"
Longits 7"x 3½"x 0.38" B.A.-Rivs. Spaced 6 Dias.
For'd of Oil Space 6'x 3"x 0.38" B.A.
Clips 3"x 4"x 0.44" I.S.
Stem-10½"x 2⅜"
Propeller Post-10½"x 7½"
Rudder Post-9"x 7½"
Transverses Spaced 8'-5"
Longit. Bkts. to Bhds. at and below 2 nd. Dk. 0.44"
Longit. Bkts. to Bhds. above 2 nd. Dk. 0.40"
Intercostal Girder 0.40"
Bottom Transverse 41"x 0.46"
Notches Rounded
Keel Pl. 51"x 0.92" for ⅜" L to 0.66"
25'-6" Mld. H. B.

Fig. 2.—Midship Section of 7,500-Ton Oil Tanker

courses is similar to that in a college. Six periods of study with the necessary home work constitute a week, three of which are devoted to practical shipbuilding and three to naval architecture. Examinations are held at opportune times, and the members of the class successfully completing their studies are given better positions, those members who are from the mold loft entering the drafting room as ship draftsmen. In this way the Union Shipbuilding Company met an emergency and was enabled to maintain a progressive drafting force.

High Cost of American Ships.—The high cost of ship construction in the United States, according to Holden A. Evans, president of the Baltimore Dry Docks & Shipbuilding Company, is due to the following: (1) High cost of wages. The wages to-day are double what they were before the war and approximately double the rates paid in Great Britain. (2) The high cost of material. Before the war steel plates could be bought at $1.10, while lately they were $3.25—approximately three times what they were before the war. All other material costs have greatly increased. (3) The inefficiency of a large number of unskilled men taken in the yards, due to the enormous plant expansion. (4) Inefficiency due to the rush of war methods. (5) The inefficiency due to the rapid increase of wages. We have plants and machinery superior to the equipment abroad; we have aggressive and efficient shipyard managers; we have ingenious and intelligent workmen, but we must build on this foundation, and it will take time and money to do this.

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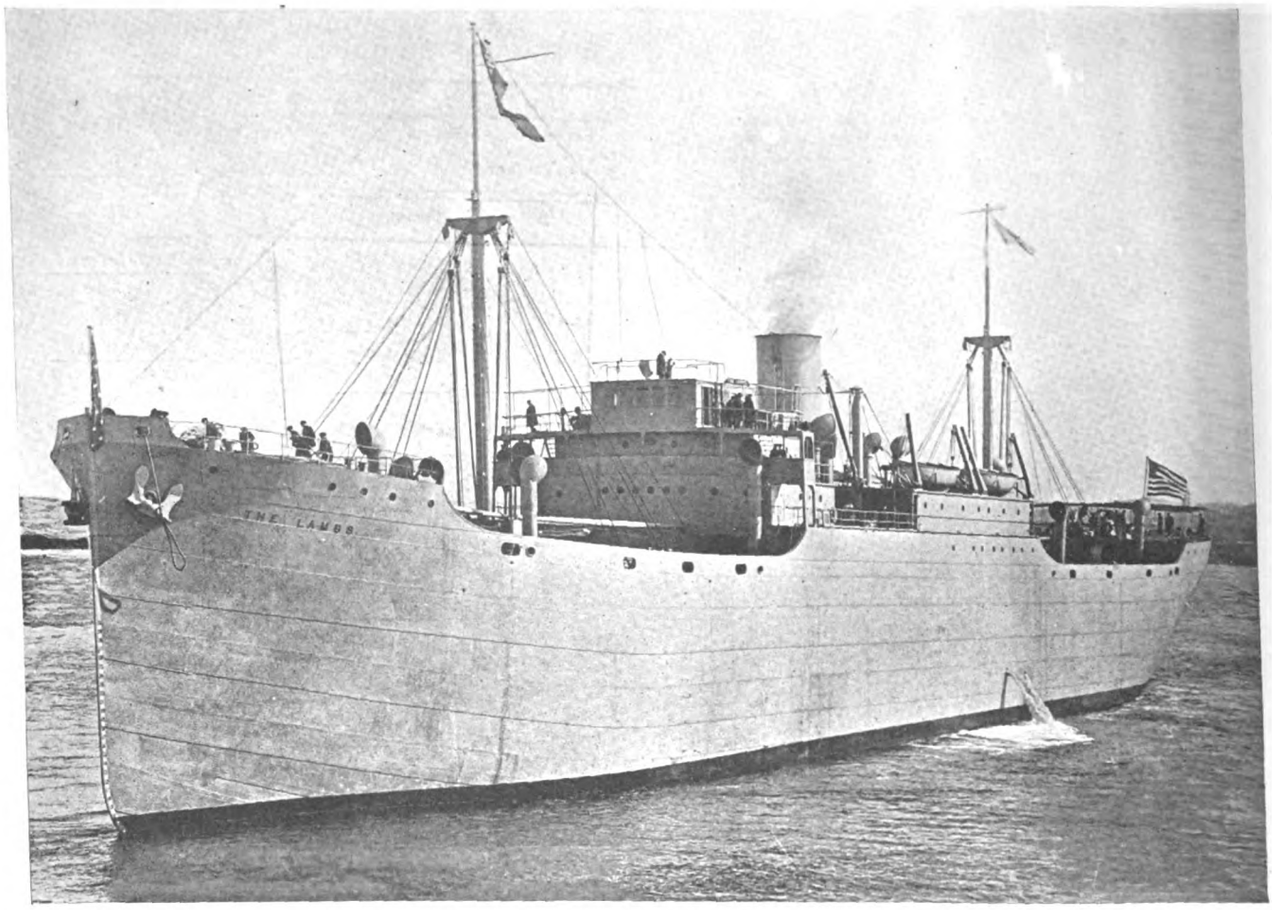

Fig. 1.—One of the 9,600-Ton Geared Turbine Cargo Steamers Built by the Federal Shipbuilding Company, Kearney, N. J.

9,600-Ton Deadweight Cargo Vessel

Economical Shelter Deck Freighter Designed by Federal Shipbuilding Company for Overseas Trade—Longitudinal Framing Adopted

THE standard type of cargo vessel which is being built by the Federal Shipbuilding Company, Kearney, N. J., is a single-screw steamship of 9,600 tons deadweight. The hull is of the shelter deck type, built on the Isherwood system of longitudinal framing, with a straight stem and elliptical stern. There are two complete steel decks and a raised poop, bridge and forecastle. The rigging consists of two steel masts and two derrick posts.

The principal dimensions of the hull are as follows:

Length between perpendiculars.....	395 feet 6 inches
Beam, molded	55 feet
Depth, molded to shelter deck.....	34 feet 11 inches
Height of 'tween decks at side.....	7 feet 11 inches
Draft, maximum	27 feet
Deadweight tonnage	9,600
Shaft horsepower	2,500

Cargo is handled by means of ten 5-ton steel booms, four on the foremast, four on the mainmast, and one on each of the derrick posts. These booms serve five cargo hatches and are handled by ten steam winches, each of the double-cylinder type, 7¼ inches by 10 inches, with single drums and two winch heads.

A double bottom of the cellular type extends throughout the length of the vessel. Under the engines and boilers the double bottom tanks can be used for fresh feed water, and under the holds for either ballast or fuel oil. The double bottom itself is divided into six transverse compartments with a watertight center keelson under the holds. Settling tanks are fitted forward of the boiler room bulkhead, extending from the tank top to the under side of the upper deck plating. The tanks have a combined capacity of about 21,000 gallons.

Five transverse watertight bulkheads divide the hull into four cargo holds. Space in the bridge deck is arranged for carrying either coal or cargo. Tubular pillars are fitted on each side of the centerline on each transverse. All of the hatches have transverse web beams spaced about 4 feet 6 inches apart to take the hatch covers. Cargo battens of 6-inch by 2-inch yellow pine are fitted between the transverses in the holds, and also in the 'tween deck and bridge spaces.

Accommodations are provided for a dining saloon and pantry in a steel deck house at the forward end of the bridge deck. The galley is located at the after end of the engine casing, and the engineers, cooks and stewards are quartered abreast the engine casing. Quarters for the captain and deck officers are located on the boat deck, while the oilers, firemen, sailors, quartermasters, boatswain, carpenter, donkeyman and storekeeper are berthed

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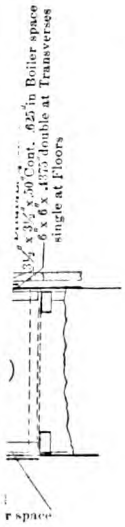

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Fig.

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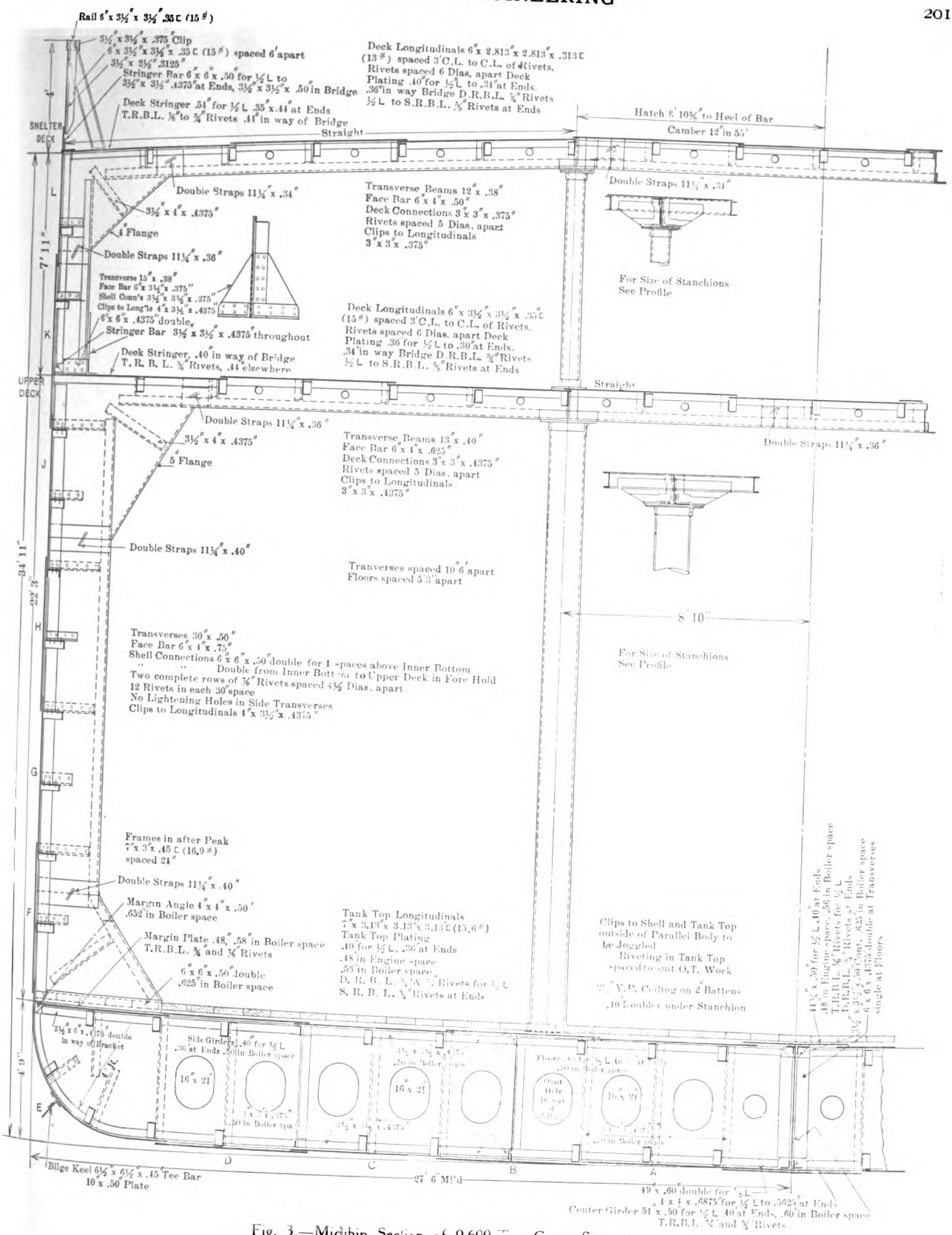
Rail 6" x 3½" x 3½" .35 C (15 #)
3½" x 3½" x .375" Clip
6" x 3½" x 3½" x .35 C (15 #) spaced 6' apart
3½" x 2½" .3125"
Stringer Bar 6" x 6" x .50" for ½ L to
3½" x 3½" .4375" at Ends, 3½" x 3½" x .50" in Bridge
Deck Stringer .51" for ½ L .35" x .44" at Ends
T.R.B.L. ⅞" to ¾" Rivets .41" in way of Bridge
SHELTER DECK
Straight
Deck Longitudinals 6" x 2.813" x 2.813" x .313 C
(13 #) spaced 3' C.L. to C.L. of Rivets.
Rivets spaced 6 Dias. apart Deck
Plating .40" for ½ L to .31" at Ends.
.36" in way Bridge D.R.B.L. ¾" Rivets
½ L to S.R.B.L. ⅞" Rivets at Ends
Hatch 8' 10⅜" to Heel of Bar
Camber 12" in 55'
Double Straps 11¼" x .34"
3½" x 4" x .4375"
4" Flange
Double Straps 11¼" x .36"
Transverse 15" x .38"
Face Bar 6" x 3½" x .375"
Shell Conn's 3½" x 3½" x .375"
Clips to Long'ls 4" x 3½" x .4375
6" x 6" x .4375" double
Stringer Bar 3½ x 3½" x .4375" throughout
Deck Stringer, .40" in way of Bridge
T. R. B. L. ¾" Rivets, .44" elsewhere
Transverse Beams 12" x .38"
Face Bar 6" x 4" x .50"
Deck Connections 3" x 3" x .375"
Rivets spaced 5 Dias. apart
Clips to Longitudinals
3" x 3" x .375"
Double Straps 11¼" x .34"
For Size of Stanchions
See Profile
Deck Longitudinals 6" x 3½" x 3½" x .35 C
(15 #) spaced 3' C.L. to C.L. of Rivets.
Rivets spaced 6 Dias. apart Deck
Plating .36 for ½ L to .30" at Ends.
.34" in way Bridge D.R.B.L. ¾" Rivets
½ L to S.R.B.L. ⅞" Rivets at Ends
UPPER DECK
Straight
Double Straps 11¼" x .36"
3½" x 4" x .4375"
5" Flange
Transverse Beams 13" x .40"
Face Bar 6" x 4" x .625"
Deck Connections 3" x 3" x .4375"
Rivets spaced 5 Dias. apart
Clips to Longitudinals
3" x 3" x .4375"
Double Straps 11¼" x .36"
Double Straps 11¼" x .40"
Tranverses spaced 10' 6" apart
Floors spaced 5' 3" apart
8' 10"
For Size of Stanchions
See Profile
Transverses 30" x .50"
Face Bar 6" x 4" x .75"
Shell Connections 6" x 6" x .50" double for 4 spaces above Inner Bottom
" " Double from Inner Bottom to Upper Deck in Fore Hold
Two complete rows of ¾" Rivets spaced 4½ Dias. apart
12 Rivets in each 30" space
No Lightening Holes in Side Transverses
Clips to Longitudinals 4" x 3½" x .4375"
Frames in after Peak
7" x 3" x .45 C (16,9 #)
spaced 21"
Double Straps 11¼" x .40"
Margin Angle 4" x 4" x .50"
.652" in Boiler space
Margin Plate .48" .58" in Boiler space
T.R.B.L. ⅞ and ¾" Rivets
6" x 6" x .50" double
.625" in Boiler space
Tank Top Longitudinals
7" x 3.13" x 3.13" x .313 C (15,6 #)
Tank Top Plating
.40" for ½ L, .36" at Ends
.48" in Engine space
.55" in Boiler space
D. R. B. L. ¾" & ⅞" Rivets for ½ L
S. R. B. L. ¾" Rivets at Ends
Clips to Shell and Tank Top
outside of Parallel Body to
be Joggled
Riveting in Tank Top
spaced to suit O.T. Work
¾" Y.P. Ceiling on 2" Battens
.40 Doubler under Stanchion
41" x .50" for ½ L .40" at Ends
.48" in Engine space, .56" in Boiler space
T.R.B.L. ¾" Rivets for ½ L
D.R.B.L. ⅞" Rivets at Ends
3½" x 3½" x .50 Cont. .625" in Boiler space
6" x 6" x .4375 double at Transverses
single at Floors
3½" x 6" x .4375" double
in way of Bracket
Side Girders .40" for ½ L
.36" at Ends .50" in Boiler space
16" x 21"
Floors .44" for ½ L to .31" at Ends
.50" in Boiler space
Unit Hole in each of 3 Plates
Bilge Keel 6½" x 6½" x .45" Tee Bar
10" x .50" Plate
27' 6" Mld'd
49" x .60" double for ½ L
4" x 4" x .6875" for ½ L to .5625" at Ends
Center Girder 51" x .50" for ½ L .40" at Ends, .60" in Boiler space
T.R.B.L. ¾" and ⅞" Rivets

Fig. 3.—Midship Section of 9,600-Ton Cargo Steamer

in the poop. Under the forecastle is a hospital, lamp room, paint room, carpenter shop and store room. The cooks' stores and cold storage rooms are located on the shelter deck abreast the engine casing. An ice machine of two tons' capacity is located on the deck below.

Living quarters throughout the vessel are heated with steam and lighted with electricity provided by two 10-kilowatt, 110-volt, compound wound generator sets, which supply direct current for an 18-inch searchlight and about 165 incandescent lamps.

In addition to the winches already mentioned, the deck machinery includes a steam steering gear, a double-cylinder 10-inch by 10-inch windlass with two wildcats and two winch heads for warping the ship, and a horizontal ballast

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pump with a 12-inch steam cylinder and 10-inch water cylinder with a stroke of 12 inches.

Propelling Machinery

The main propelling machinery is located amidships and consists of a geared turbine of 2,500 shaft horsepower supplied with steam at 210 pounds per square inch and 50 degrees superheat by three single-end Scotch boilers. The turbine is of the Curtis type supplied by the General Electric Company and drives the propeller shaft at a speed of 90 revolutions per minute through a double-reduction gear, giving the vessel a speed of 11 knots. Incorporated in the casing of the ahead turbine is an astern turbine, which is designed to develop not less than two-thirds the full speed ahead torque on not more than two-thirds of the full speed revolutions. With steam at 190 pounds gage and 50 degrees superheat at the throttle and 28 inches vacuum in the condenser, the steam consumption of the turbine at normal speed at full power is guaranteed to be not more than 12 pounds per shaft horsepower per hour.

The propeller is a solid four-bladed right-hand screw, 17 feet diameter, attached to a 14-inch propeller shaft. The line shafting is 13 inches diameter, and the thrust shaft 13¾ inches diameter. The thrust bearing is of the horseshoe type.

The turbine oiling system provides for draining the oil from the turbine and gears to a 350-gallon tank, from which two horizontal duplex oil pumps, 7 inches and 7 inches by 10 inches, pump the oil to the supply tanks.

The engine room auxiliaries include a main condenser of 3,500 square feet cooling surface, a centrifugal circulating pump with 14-inch suction and discharge having a capacity of 5,000 gallons per minute against a head of 15 feet, a twin-beam wet and dry air pump, and the following service pumps:

Pumps

Two main and auxiliary feed, 12 inches and 8 inches by 18 inches, vertical simplex.

One ballast, 12 inches and 10¾ inches by 12 inches, horizontal duplex.

One fire and bilge, 12 inches and 8½ inches by 12 inches, horizontal duplex.

One engine room bilge, 6 inches and 5¾ inches by 6 inches, horizontal duplex.

One sanitary, 7½ inches and 5 inches by 6 inches, horizontal duplex.

One fresh water, 7½ inches and 5 inches by 6 inches, horizontal duplex.

One evaporator feed and ice machine condenser pump, 7½ inches and 5 inches by 6 inches, horizontal duplex.

Two lubricating oil, 7 inches and 7 inches by 10 inches, horizontal duplex.

One lubricating oil cooler, 7 inches and 7 inches by 10 inches, horizontal duplex.

One fuel oil transfer, 7½ inches and 6 inches by 10 inches, horizontal duplex.

Two oil fuel service, 5¼ inches and 3½ inches by 5 inches, horizontal duplex.

One combined air and circulating auxiliary, 10 inches and 12 inches and 12 inches by 12 inches, horizontal duplex.

The engine room equipment also includes a feed heater, capable of heating 35,000 pounds of water per hour from 80 degrees to 212 degrees Fahrenheit when using exhaust steam at 5 pounds gage pressure; a feed water and filter tank of 750 gallons capacity; an evaporator with a capacity of 20 tons in twenty-four hours; a distiller of 2,000 gallons capacity, and an auxiliary condenser with 800 square feet cooling surface.

Boilers

Steam is furnished at 210 pounds per square inch working pressure by three single-end Scotch boilers, 15 feet 6 inches inside diameter by 11 feet 6 inches long. Each boiler has three Morison corrugated furnaces, 45 inches inside diameter, with a separate combustion chamber for each furnace. All of the tubes, except the ten top rows, are 2¾ inches outside diameter. The tubes in the top rows are stay tubes, 4¾ inches outside diameter, and in the two top rows are fitted the superheater units, consisting of U-bends of 1¼-inch tubes, expanded into headers consisting of 7-inch seamless-drawn tubing ½-inch thick.

The boilers are oil-fired and operate under forced draft. The oil burners are of the mechanical atomizing type. The oil is pumped from the double bottom tanks to the settling tanks by a horizontal duplex pump, 7½ inches and 6 inches by 10 inches, and from the settling tanks to the burners by two horizontal duplex pumps, 5¼ inches and 3½ inches by 5 inches.

Other Yards Building Vessels to Same Design

Vessels of this size and of practically the same design are being built to the order of the United States Shipping Board Emergency Fleet Corporation in two other yards. The Carolina Shipbuilding Corporation is building twelve vessels of this type at its yard in Wilmington, N. C., which are fitted with coal-burning watertube boilers with a total heating surface of 9,000 square feet, operating under induced draft and furnishing steam superheated at 50 degrees at a pressure of 200 pounds per square inch to a triple-expansion reciprocating engine of 2,800 indicated horsepower for the propulsion of the vessel. The main engine has cylinders 24½ inches, 41½ inches and 72 inches diameter by 48 inches stroke.

Doullut & Williams are also building eight vessels of this type for the Emergency Fleet Corporation at their yard in New Orleans, La. These vessels are fitted with coal-burning watertube boilers, furnishing steam at 225 pounds per square inch pressure and 75 degrees superheat to a set of Parsons double-reduction geared turbines of 2,800 shaft horsepower, designed to drive the propeller shaft at 90 revolutions per minute.

Bunker Coal for Transatlantic Shipping

Strict regulations govern shipments to the Atlantic seaboard of coal intended for the bunkering of ships. Only the highest grade of coal for steam making is permitted for this service, to the end that each ship shall have a greater steaming radius and higher speed.

Under regulations issued in April, 1918, by Fuel Administrator Garfield, it is prohibited that coal be delivered to any Atlantic or Gulf port for bunkering purposes other than that specified by the Fuel Administration as permissible bunker coal. The shipment of coal smaller than run of mine to any port for bunkering purposes or to any pool designated as a "permissible coal pool" is prohibited, except when special permission is granted by the Fuel Administration. On July 2, 1918, twenty-five additional inspectors were appointed to supervise more thoroughly the preparation of coal for ships.

Orders issued by the Fuel Administration, effective July 23 and July 31, 1918, revised former regulations relative to the required quality and grades of coal for bunkering steamships. The purpose of the orders was to improve the quality and enlarge the quantity of coal for ships in the Atlantic trade.

The removal of the submarine menace to shipping after the signing of the armistice enabled the Fuel Administration, by an order issued on November 25, to make coal supplies available for bunkering purposes from pools Nos. 4 and 10, the use of coal from these pools being prohibited heretofore because its smoke-producing qualities invited attack by U-boats. The addition of these pools enables the more expeditious movement of transatlantic shipping.

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HOG ISLAND SHIPS OF 7,500 TONS DEADWEIGHT

Built by the American International Shipbuilding Corporation

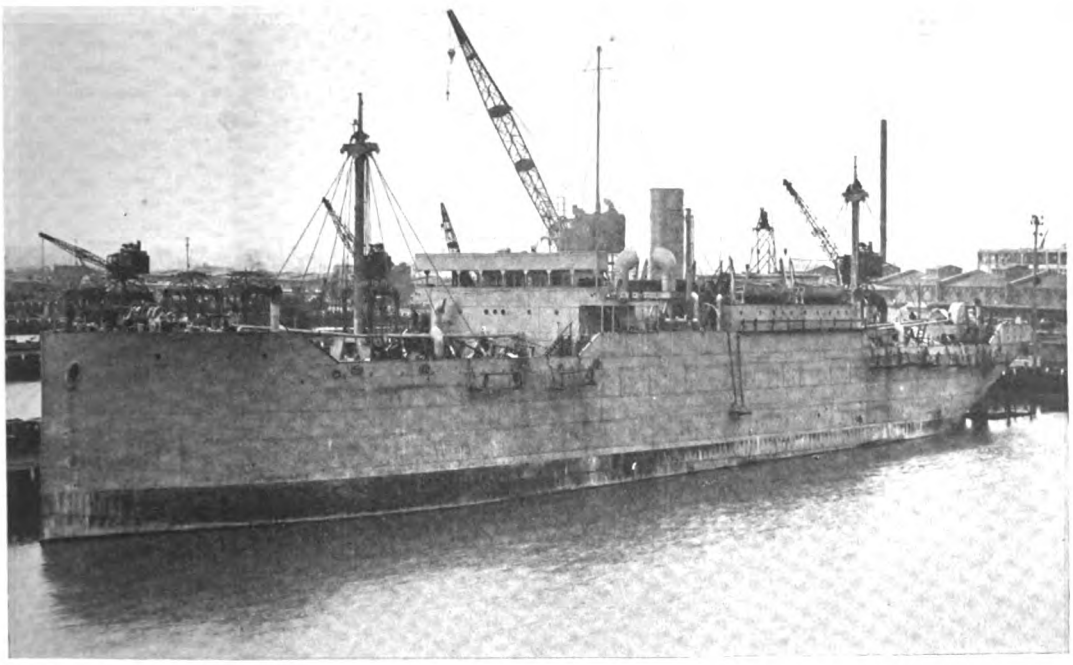

Fig. 1.—7,500-Ton Cargo Ship at Fitting-Out Berth, Hog Island, Pa.

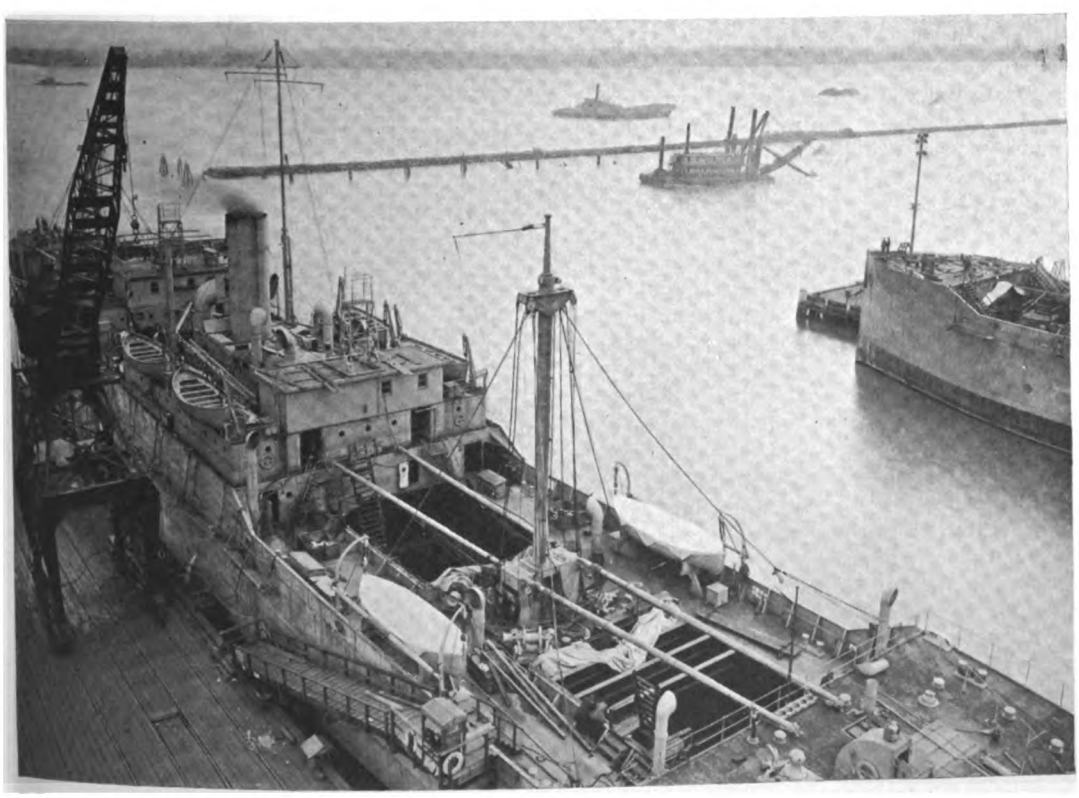

Fig. 2.—Portable Tower Crane in Operation at Fitting-Out Berth, Hog Island Yard, 7,500-Ton Vessel Alongside

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"Robert Dollar" Type of Cargo Vessel

Designed by Skinner & Eddy Corporation, Seattle, Wash., to Carry 8,800 Tons Deadweight at Sea Speed of 11½ Knots

ONE of the first of the new shipyards in the United States to seize upon the advantages of standardized ship production was the Skinner & Eddy Corporation, Seattle, Wash. This company selected a single-screw cargo vessel of 8,800 tons deadweight carrying capacity, commonly called the "*Robert Dollar*" type from the name of the first vessel built to this design. The principal dimensions of the ship are as follows:

Length overall	423 feet 9 inches
Lloyd's length	410 feet 5½ inches
Beam, molded	54 feet
Depth, molded	29 feet 9 inches
Draft, full load	24 feet 2 inches
Speed on trial	11½ knots
Cubic capacity (grain), about	460,000 cubic feet
Cubic capacity (bales), about	420,000 cubic feet
Deadweight tonnage at load draft	8,800 tons
Coal bunker capacity (permanent), about	700 tons
Coal bunker, reserve, (either coal or cargo)	830 tons
Fresh water capacity, about	200 tons
Fore peak tank, about	120 tons
After peak tank, about	320 tons
Total water ballast (exclusive of fresh water), about	1,460 tons
Gross tonnage, about	5,700 tons
Net tonnage, about	4,400 tons

The vessel is of the forecastle, poop and bridge type, with the machinery amidships, and is rigged with two masts with four 5-ton cargo booms on each mast and two derrick posts each fitted with one 3-ton cargo boom. A 30-ton boom for handling heavy weights is fitted on the foremast.

The forward hold is divided into two compartments by a transverse watertight bulkhead, but no transverse watertight bulkheads are fitted in the after hold. The permanent coal bunkers are just forward of the fireroom and in the 'tween decks around the machinery casing. The bridge house may be used for either cargo or as a reserve coal bunker.

Water ballast is carried in the peak tanks and in the double bottom. The reserve feed and fresh water is carried in the double bottom under the machinery space, while the drinking water is carried in separate tanks in the bridge house.

Cargo is handled through four large and one small cargo hatches through the upper and second decks.

Hull Construction

The double bottom is divided by watertight floors and a watertight centerline keelson into fourteen compartments. Bilge wells are located at each end of the machinery space. In the double bottom the frames and reverse frames are angles, while above the tank the frames are channels spaced 27 inches apart, except in the peaks, where they are spaced 24 inches apart.

All the floors are of solid plate with lightening holes. Two longitudinals are fitted on each side of the center keelson in the double bottom. The margin plates are fitted at right angles to the frames.

Web frames are fitted in the engine room, and, where necessary in both the engine and boiler rooms, strong beams are fitted.

The upper deck beams are channels placed on every frame, and the second deck beams are channels placed on alternate frames. Both the upper and second decks are complete steel decks.

Above the tank top the hull is subdivided by five transverse watertight bulkheads and a non-watertight steel bulkhead forward of the athwartship coal bunker. Between the engine and fire rooms there is a steel screen bulkhead. All of the watertight bulkheads extend to the upper deck.

In the holds, side stringers are fitted and two rows of wide-spaced pillars built up of plates and structural shapes. The inner bottom is ceiled with 3-inch fir under the cargo hatches only. Cargo battens of 6-inch by 2-inch fir, spaced 9 inches, are fitted in the holds and 'tween deck cargo spaces.

Deck Machinery

A spur-geared horizontal-type steam windlass, with two wildcats and two large warping ends, is fitted on the forecastle. At each hatch there are two horizontal-geared steam winches with cylinders 8 inches by 10 inches, each giving a drum duty of about 5,000 tons on a single whip. A steam steering gear of the right- and left-hand type is fitted in the poop, together with a horizontal single-geared warping winch.

Living quarters on the vessel are heated by steam and lighted by electricity supplied by two 15-kilowatt compound-wound multi-polar 110-volt generator sets.

Boilers

Steam is supplied at 210 pounds gage pressure by three single-end Scotch boilers, 14 feet 9 inches inside diameter and 11 feet long. Each boiler has a heating surface of 2,500 square feet and a grate area of 60 square feet. The furnaces are corrugated with an inside diameter of 43¾ inches, each furnace leading to a separate combustion chamber 34 inches deep.

The boilers are coal-fired and operate under forced draft, the uptakes leading to a single stack 8 feet in diameter, extending to a height of 80 feet above the keel.

Propelling Machinery

Propulsion is by a single four-bladed propeller about 16 feet 6 inches diameter, which in this type of vessel may be driven by either a triple-expansion reciprocating engine or a geared turbine. If a reciprocating engine is installed, the cylinders are 25 inches, 42 inches and 72 inches diameter by 48 inches stroke, designed to develop about 2,700 indicated horsepower at a speed of 80 revolutions per minute. The high-pressure and intermediate-pressure cylinders are each fitted with a single piston valve, and the low-pressure cylinder with two piston valves. Balance pistons are fitted on top of the intermediate-pressure and low-pressure valve stems.

The thrust bearing is of the horseshoe type with eight solid collars each 22½ inches diameter and 2 inches thick. The thrust shaft is 14½ inches diameter, the line shafting, in seven sections, 13¾ inches diameter, and the propeller shaft 14¾ inches diameter.

The main condenser is independent with about 3,7[illegible] square feet of cooling surface. The main circulating pump is of the double-suction centrifugal type with suction and discharge connections, 14 inches diameter, driven by a single-cylinder engine. The main air pump is of the

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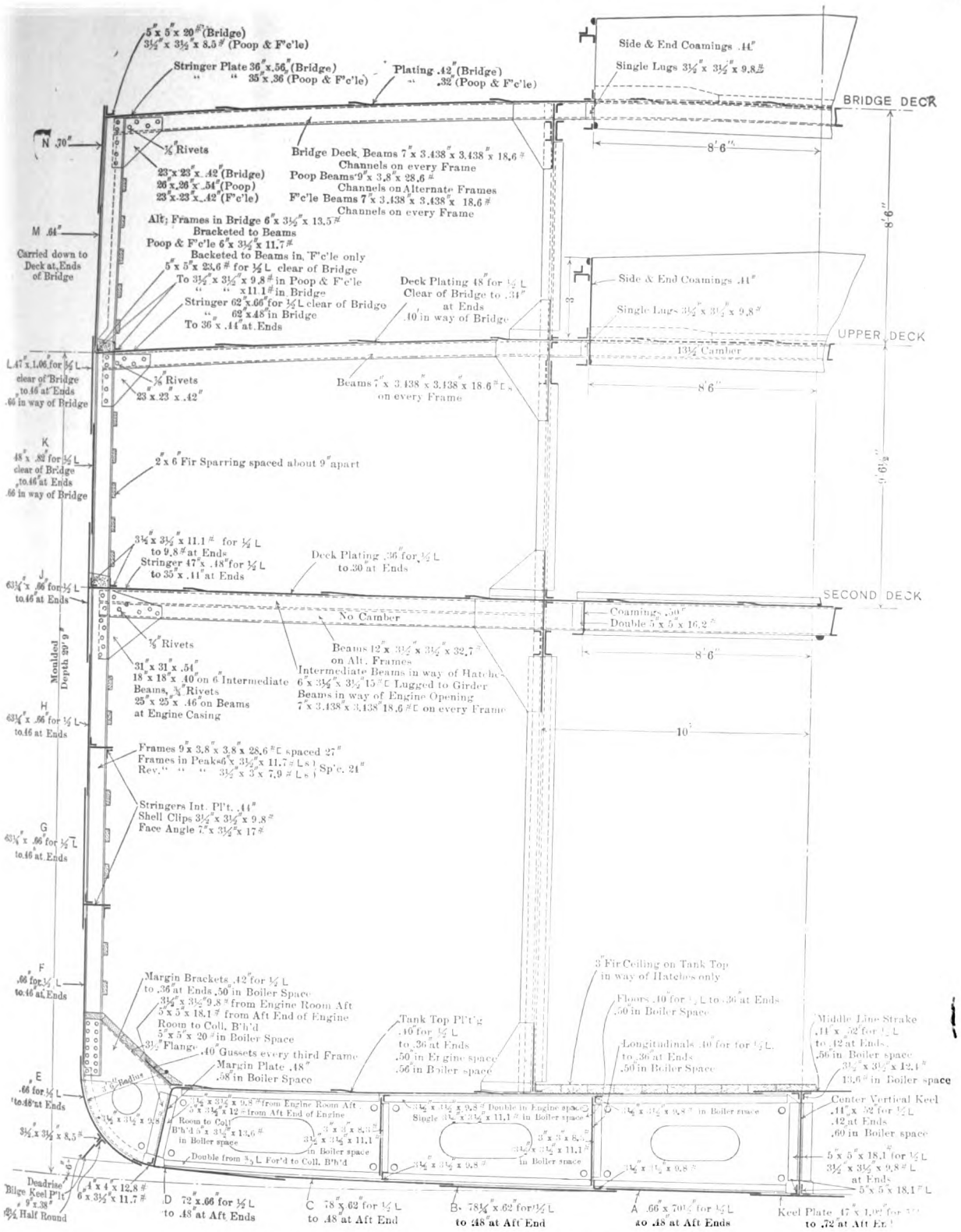
BRIDGE DECK
UPPER DECK
SECOND DECK
Moulded Depth 39' 9"
Side & End Coamings .44"
Single Lugs 3½" x 3½" x 9.8#
Bridge Deck Beams 7" x 3.438" x 3.438" x 18.6#
Channels on every Frame
Poop Beams 9" x 3.8" x 28.6#
Channels on Alternate Frames
F'c'le Beams 7" x 3.438" x 3.438" x 18.6#
Channels on every Frame
Deck Plating .48" for ½ L
Clear of Bridge to .34"
at Ends
.40 in way of Bridge
Beams 7" x 3.438" x 3.438" x 18.6# L
on every Frame
2" x 6" Fir Sparring spaced about 9" apart
Deck Plating .36" for ½ L
to .30" at Ends
No Camber
Coamings .50"
Double 5" x 5" x 16.2#
Intermediate Beams in way of Hatches
6" x 3½" x 15.3# L Lugged to Girder
Beams in way of Engine Opening
7" x 3.438" x 3.438" 18.6# L on every Frame
Frames 9" x 3.8" x 3.8" x 28.6# L spaced 27"
Stringers Int. Pl't. .44"
Shell Clips 3½" x 3½" x 9.8#
Face Angle 7" x 3½" x 17#
3" Fir Ceiling on Tank Top
in way of Hatches only
Floors .40" for ½ L to .36" at Ends
.50" in Boiler Space
Tank Top Pl'ts
.40" for ½ L
to .36" at Ends
.50" in Engine space
.56" in Boiler space
Longitudinals .40" for for ½ L
to .36" at Ends
.50" in Boiler Space
Middle Line Strake
.44" x .92" for ½ L
to .42" at Ends
.56" in Boiler space
Center Vertical Keel
.44" x .92" for ½ L
.42" at Ends
.60" in Boiler space
Margin Brackets .42" for ½ L
to .36" at Ends .50" in Boiler Space
Margin Plate .48"
.58" in Boiler Space
Keel Plate .47" x 1.02" for ½ L
to .72" at Aft End
Deadrise
Bilge Keel Pl't
Half Round

Fig. 2.—Midship Section of 8,800-Ton Cargo Vessel

vertical twinplex type with a steam cylinder 14 inches diameter and two air cylinders each 28 inches diameter by 18 inches stroke. The following pumps are also provided:

PUMPS

Two vertical simplex main and auxiliary feed, 12 inches and 8 inches by 18 inches.

One horizontal duplex ballast, 12 inches and 10¼ inches by 12 inches.

One horizontal duplex fire and bilge, 12 inches and 8½ inches by 12 inches.

One horizontal duplex engine room bilge, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex sanitary, 7½ inches and 5 inches by 6 inches.

One horizontal duplex fresh water, 7½ inches and 5 inches by 6 inches.

The engine room auxiliaries include an auxiliary condenser with 950 square feet of cooling surface served by a horizontal combined air and circulating pump, 10 inches by 12 inches by 12 inches by 12 inches; a filter and feed tank containing about 90 cubic feet; a horizontal closed

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type feed heater; a 2-inch injector; an evaporator with a daily capacity of 5 tons, and a distiller. The feed heater is designed to heat the water to 220 degrees F.

Turbine Machinery

If geared turbine machinery is installed as the main propelling machinery, the turbine is of the Curtis type of 2,500 shaft horsepower with five ahead stages and two backing stages, both on the same shaft. The turbine drives the propeller shaft at a speed of 90 revolutions per minute through two sets of double helical gearing. With steam at 200 pounds pressure at the throttle and 50 degrees F. superheat with a vacuum of 28 inches in the condenser, the steam consumption is guaranteed at not over 12 pounds per shaft horsepower per hour.

With the turbine machinery the thrust shaft is 13¼ inches diameter, the line shaft 12¾ inches diameter, and the propeller shaft 14 inches diameter. The propeller is of the four-bladed built-up type, 16 feet 6 inches diameter and 13 feet 6 inches pitch.

The main condenser provides 4,000 square feet of cooling surface and two horizontal duplex, 6-inch by 7½-inch by 6-inch pumps are installed for the turbine oil-cooling system.

Standard Sea-Going Cargo Vessel of 3,500-Tons Deadweight Built on the Lakes

Single-Deck Steamer of Maximum Welland Canal Size—Tonnage of Later Vessels Increased to 4,200

In order to pass through the locks of the Welland Canal to reach the seaboard, sea-going vessels built on the Great Lakes are limited to an overall length of about 261 feet. As every effort was made during the war to deliver to the seaboard a maximum amount of tonnage from the Great Lakes, practically every shipyard on the Lakes received orders to build a standard type of vessel of the maximum size that could navigate the Welland Canal. The design adopted called for a single-screw, single-deck type vessel of 3,500 tons deadweight of the following dimensions:

Length overall	261 feet
Length betwen perpendiculars	251 feet
Beam, molded	43 feet 6 inches
Depth, molded at side to main deck	24 feet 2½ inches
Load draft, about	21 feet
Block coefficient	0.797
Deadweight carrying capacity (not including spare parts or water in boilers)	3,500 tons
Indicated horsepower	1,250
Speed	11 knots

As shown by the plans, the hull has a straight stem and elliptical stern, a complete double bottom and single deck with poop, bridge and forecastle. To aid in camouflaging the vessels during the war, only a single steel mast was fitted amidships, and for handling the cargo derricks two hinged derrick masts were fitted. In ordinary times this type of vessel would be fitted with two steel masts, from which the cargo booms are operated.

Hull Construction

The hull is subdivided by four watertight transverse bulkheads, extending to the main deck into two cargo holds, and a machinery space amidships. Access to the cargo holds is gained by four main hatches served by 4-ton cargo booms, two being provided for each hatch.

In the subdivision of the hull, the forward and after peaks are used for water ballast and trimming tanks. The No. 1 double-bottom tank extends clear across the ship, with a non-watertight center division forming a single tank for water ballast. The No. 2 double-bottom tank has a watertight center division, providing two separate tanks for ballast. No. 3 double-bottom tank has a watertight center division, forming two feed water tanks. No. 4 double-bottom tank is divided by a watertight center division into two ballast tanks, while No. 5 tank has a non-watertight center division, forming a single-ballast tank.

The double bottom extends from the forward collision bulkhead to the after peak. Solid floors are fitted on every third frame, and the entire double bottom is divided by watertight floors into five fore-and-aft compartments.

Outside the double bottom the frames are channels spaced 24 inches apart. In the inner bottom on solid floors the frames are of angles, and on open floors channels. The reverse frames are angles on all solid floors in the double bottom, and channels on open floors. All of the floors under the engine and boiler spaces are solid, with lightening holes. Forward of the machinery space, to three-fifths the length, every third floor is solid between the center keelson and margin, the balance being of bracket construction.

One longitudinal is fitted on each side, intercostal between the solid floors and increased in thickness in the machinery space. The margin is of the diagonal type.

Web frames are fitted in the engine and boiler spaces and forward where required. Side stringers are fitted forward only.

The main deck beams consist of channels fitted to every frame, the camber of the beams being 10½ inches in a length of 43 feet 6 inches.

The four cargo hatches through the main deck are each 18 feet wide by 22 feet long. These hatches are served by eight 4-ton cargo booms, for each of which there is a two-cylinder reversible single-drum winch with cylinders 8¼ inches by 8 inches.

Fresh water for culinary purposes is carried in two fresh water tanks on the bridge deck, with a total capacity of about 6,500 gallons. The bunkers are fitted on each side of the boiler and engine spaces and in the bridge space over the boilers. An emergency bunker is also provided in the after end of the No. 1 hold.

The living spaces in the vessel are heated with steam and lighted by electricity furnished by a 10-kilowatt generator. Provision is made for lighting the cargo holds by portable clusters.

In addition to the foregoing, the deck machinery includes the necessary windlasses and capstans, steam steering gear and an ice machine of 1-ton capacity.

Steam is furnished at a pressure of 180 pounds per square inch by two single-end two-furnace Scotch boilers.

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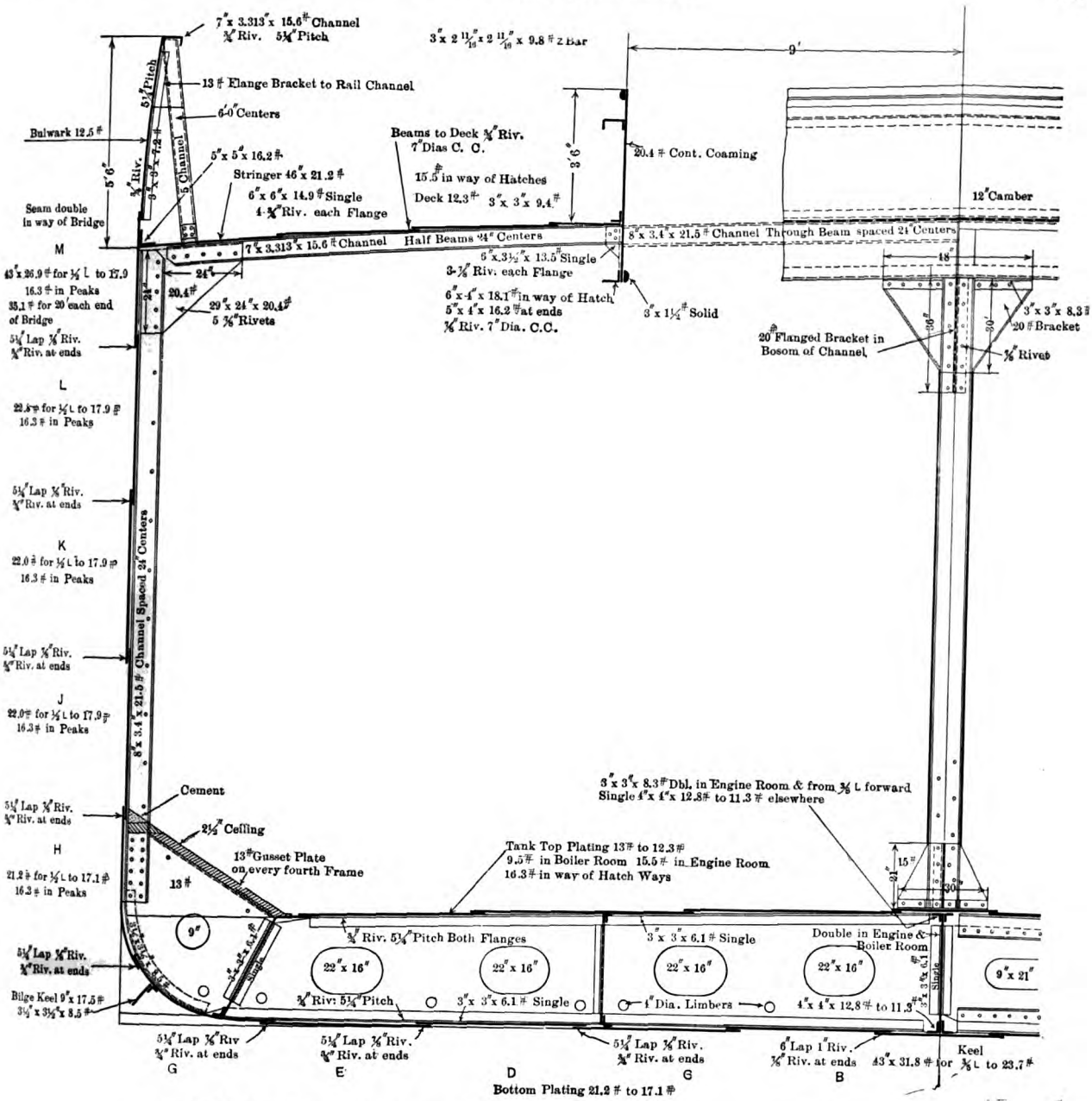
7"x 3.313"x 15.6# Channel
¾" Riv. 5¼" Pitch
3"x 2 11/16"x 2 11/16" x 9.8# Z Bar
9'
13# Flange Bracket to Rail Channel
6'-0" Centers
Bulwark 12.5#
Beams to Deck ¾" Riv.
7" Dias C. C.
20.4# Cont. Coaming
15.5# in way of Hatches
Deck 12.3#
3"x 3"x 9.4#
12" Camber
Seam double in way of Bridge
5"x 5"x 16.2#
Stringer 46"x 21.2#
6"x 6"x 14.9# Single
4-¾" Riv. each Flange
7"x 3.313"x 15.6# Channel Half Beams 24" Centers
8"x 3.4"x 21.5# Channel Through Beam spaced 24" Centers
5"x 3½"x 13.5# Single
3-⅞" Riv. each Flange
6"x 4"x 18.1# in way of Hatch
5"x 4"x 16.2# at ends
⅞" Riv. 7" Dia. C.C.
3"x 1¼" Solid
20# Flanged Bracket in Bosom of Channel
3"x 3"x 8.3#
20# Bracket
⅞" Rivets
M
43"x 26.9# for ½ L to 17.9
16.3# in Peaks
35.1# for 20' each end of Bridge
29"x 24"x 20.4#
5 ⅞" Rivets
5¼" Lap ⅞" Riv.
¾" Riv. at ends
L
22.8# for ½ L to 17.9#
16.3# in Peaks
K
22.0# for ½ L to 17.9#
16.3# in Peaks
J
22.0# for ½ L to 17.9#
16.3# in Peaks
8"x 3.4"x 21.5# Channel Spaced 24" Centers
Cement
2½" Ceiling
H
21.2# for ½ L to 17.1#
16.3# in Peaks
13# Gusset Plate on every fourth Frame
Tank Top Plating 13# to 12.3#
9.5# in Boiler Room 15.5# in Engine Room
16.3# in way of Hatch Ways
3"x 3"x 8.3# Dbl. in Engine Room & from ⅜ L forward
Single 4"x 4"x 12.8# to 11.3# elsewhere
¾" Riv. 5¼" Pitch Both Flanges
3"x 3"x 6.1# Single
Double in Engine & Boiler Room
22"x 16"
9"x 21"
¾" Riv. 5¼" Pitch
3"x 3"x 6.1# Single
1" Dia. Limbers
4"x 4"x 12.8# to 11.3#
Bilge Keel 9"x 17.5#
3½"x 3½"x 8.5#
G
E
D
G
B
6" Lap 1" Riv.
⅞" Riv. at ends
43"x 31.8# for ⅜ L to 23.7#
Keel
Bottom Plating 21.2# to 17.1#

Fig. 2.—Midship Section of Standard 3,500-Ton Cargo Steamer Built on the Great Lakes

13 feet mean diameter by 11 feet length, located in a single fireroom with the grates fore-and-aft and operating under heated forced draft. The boilers have a total heating surface of 3,900 square feet and a total grate area of 88 square feet. Each boiler has two Morison corrugated furnaces 48 inches inside diameter. Separate combustion chambers are provided for each furnace.

PROPELLING MACHINERY

Propulsion is by a solid cast iron four-bladed propeller, 13 feet 7½ inches diameter, driven at a speed of 85 revolutions per minute by a double-acting inverted triple-expansion reciprocating engine with cylinders 20 inches, 33 inches and 54 inches diameter by 40 inches stroke, designed to develop 1,250 indicated horsepower. The piston speed of the engine is about 566 feet per minute. The framing of the main engine consists of six cast iron box columns, the cylinders are placed from forward to aft, high pressure, intermediate pressure, low pressure and the

(*Concluded on page 245*)

Economies Expected by Welding Ships

The economies which it is hoped to achieve by welding ships are far from beginning and ending with the saving of time and labor in riveting. It is pointed out that a 10,000-ton ship costing $1,900,000 (£400,000) now costs but $83,000 (£17,500) to rivet, and that if electric welding only promises to modify this amount, no very substantial gain will be obtained. Many other benefits will, it is hoped, follow the change from riveting to welding, and tests have in view the abolition or at least the lessening of the transportation from the rolling mill to the fabricating plant when the latter is not at the shipyard; the template makers' work; the markers' work; the punching, and much of the work of the fitters and bolters who flog and pull the pieces so as to make them fit when on the ways. It is estimated that, taking into consideration all the above items, a saving of one month in the time of construction and of no less than $38 (£8) a ton in the cost of the steel structure may be made, the total saving in cost being $97,500 (£20,000) on a 10,000-ton vessel.

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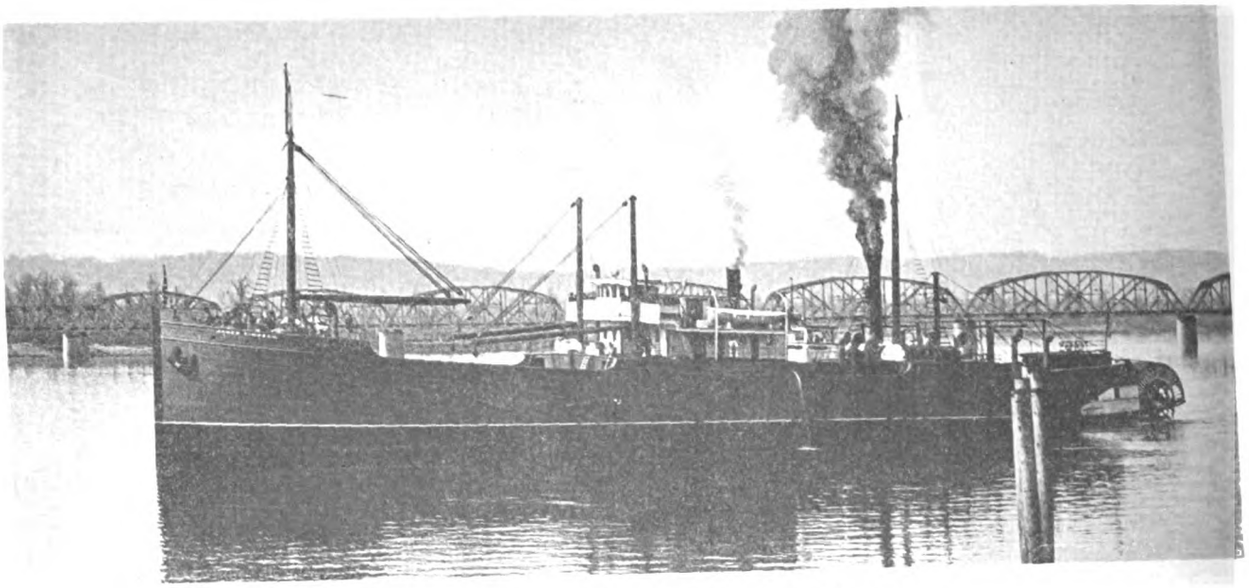

Fig. 1.—Twin-Screw Wooden Motorship *James Timpson*

American Diesel-Engined Motorship

Gear-Reduction Transmission Applied to Twin-Screw Wooden Freighter Equipped with Moderately High-Speed Diesel Engines

AMONG the new features which have been introduced in the propulsion of vessels very recently, mechanical reduction gears have played an important part in the equipment of slow-speed steamships fitted with high-speed turbines. For the first time this idea has been applied in a similar manner to the power plant of a Diesel-engined motorship where the engines are of moderately high speed and the service of the vessel that of an ordinary tramp.

The vessel in which this installation was made is the twin-screw wooden motorship *James Timpson*, designed by Cox & Stevens, naval architects, New York, for I. T. Williams & Sons, New York, and built by the Standifer Construction Company, Vancouver, Wash. The vessel has a deadweight carrying capacity of about 3,000 tons on a load draft of 23 feet. Its length overall is 280 feet and between perpendiculars 268 feet, with a beam of 46 feet and depth of 22 feet.

Propulsion is by twin screws driven by 6-cylinder, single-acting, direct-reversible, four-cycle Winton Diesel-type engines, built by the Winton Engine Company, Cleveland, Ohio, operating through mechanical gear-reduction transmission. The engines have cylinders 12 15/16 inches diameter by 18 inches stroke and are rated at 500 brake horsepower, making the total power of the vessel 1,000 brake horsepower. The reduction gears are of the Falk double-helical type, with both gears floating and built with a ratio of 3 to 1, supplied by the Falk Company, Milwaukee, Wis. With a full cargo, the vessel maintains an average cruising speed of 8.78 knots.

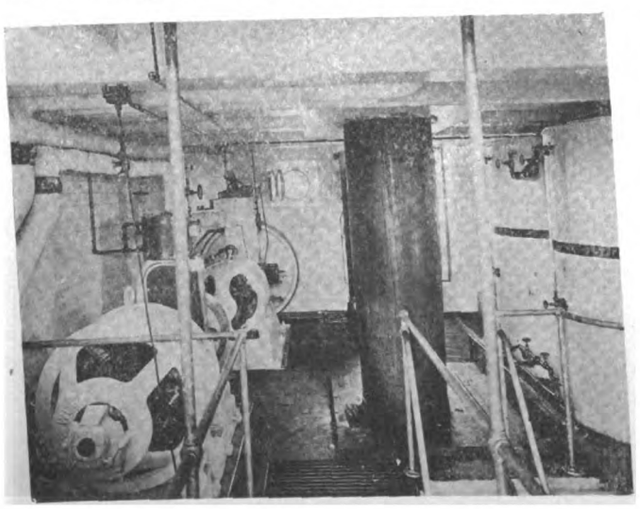

Fig. 2.—Auxiliary Steam-Driven Generator in Foreground; Main Generator Operated by 15-Horsepower Oil Engine in Background

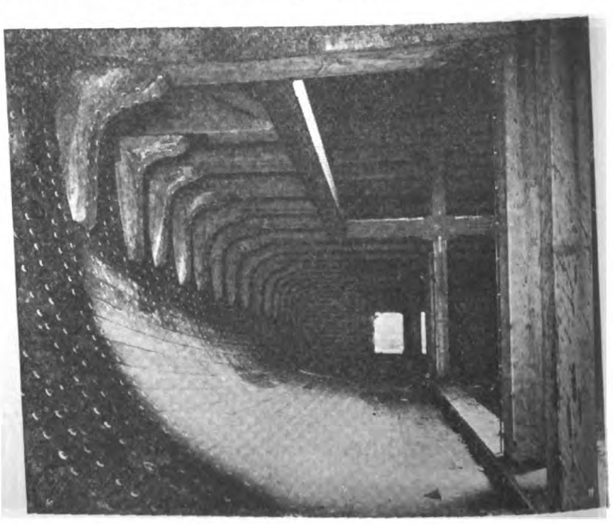

Fig. 3.—View in the Hold Showing Type of Hull Construction, Stanchions and Deck Beam Knees

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The auxiliaries consist of an oil-burning donkey boiler supplying steam for the operation of an auxiliary air compressor, an auxiliary 12-kilowatt electric generator, bilge pumps and deck winches, and also for heating the vessel. The main lighting unit consists of a 10-kilowatt generator, driven by a 15-horsepower oil engine. Steering is by means of a Herzog electrical steering gear operated by a 1½ brake horsepower electric motor connected to a reduction gear attached to the rudder stock.

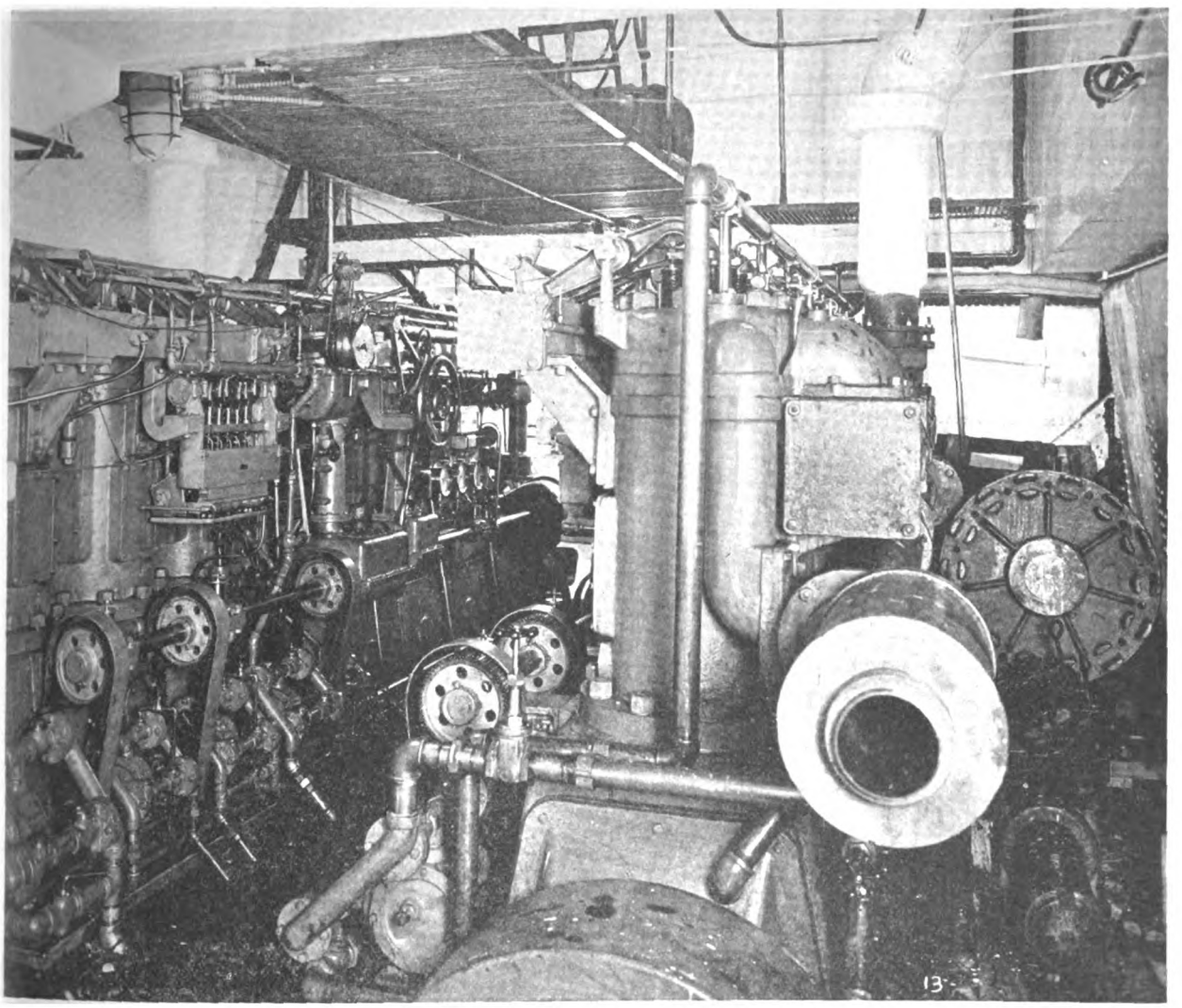

Fig. 4.—Engine Room. Main Engines Are of Winton 6-Cylinder Diesel Type, of 500 Brake-Horsepower Each, Driving the Propellers Through 3 to 1 Falk Double Helical Reduction Gears

Chief Engineer Charles K. Wirosteck, in a recent report, stated that the ship had logged a trifle over 14,500 miles, and that during that time he had experienced no trouble with the main power plant or with the reduction gears; the only serious trouble developing was from the donkey steam boiler, which gave more or less trouble throughout the various trips; in fact, it was necessary to make practically a new installation of this equipment recently, and a new system of fuel injection and burning for the steam boiler was installed, so that better efficiency from this part of the power plant is now to be expected.

Beyond the fact that this boat is equipped with all-American Diesel engines, it is also equipped with reduction gears, one of the first American Diesel motorships to be so equipped. The gears were built by Falk, of Milwaukee, and are on a 3-to-1 ratio with both sets of gears floated. Cut from solid chunks of chrome nickel steel, of the double-helical type, these gears have run 14,500 miles to date without giving a moment's trouble, without overheating once, and to-day they do not show any wear. In fact, it is hard to believe they have been in service at all. The use of these reduction gears makes it possible to install a much more compact and lighter power plant. The engines operate at from 265 to 300 revolutions per minute, and the propellers at 75 to 85 revolutions per minute. The propellers are 9 feet 8 inches by 11 feet, four-bladed.

Unfortunately, a complete record of fuel consumption is not available, as the fuel oil is carried in main storage tanks, from which the main power plant, the donkey boiler and the generating set obtain their fuel, and it is impossible to figure the consumption of each unit separately. The log shows, however, that from the time the boat left her yard at Vancouver, Wash., until she arrived in New York city, she took aboard 2,200 barrels of fuel oil, during which time her main engines were in operation 1,650 hours, the total distance logged being a trifle over 14,500 knots. Consequently, her daily fuel consumption for all units of the power plant averaged between four and five tons (28 to 35 barrels) with the engines operating at

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Fig. 5.—Bow View of M. S. *James Timpson*

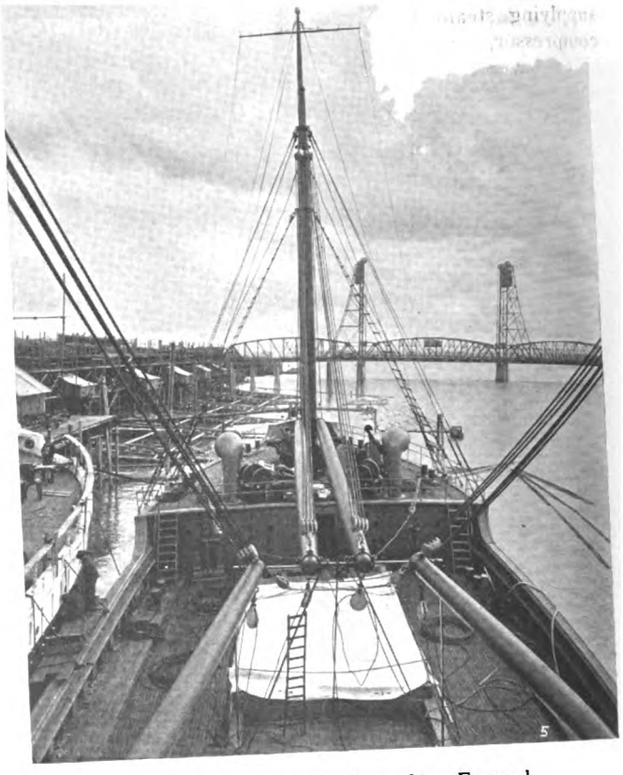

Fig. 7.—Main Deck, Looking Forward

continuous full load. This represents 3,000 tons of cargo carried on an average of 1.35 barrels of fuel oil per hour for a 24-hour day.

The ports called at were:

1.	Vancouver	Levinton, Ore.
2.	Levinton, Ore.	Marshfield, Ore.
3.	Marshfield, Ore.	San Francisco, Cal.
4.	San Francisco, Cal.	Bay Point, Cal.
5.	Bay Point, Cal.	San Francisco, Cal.
6.	San Francisco, Cal.	Eureka, Cal.
7.	Eureka, Cal.	San Francisco, Cal.
8.	San Francisco, Cal.	Panama, Canal Zone
9.	Panama, Canal Zone	Majellones, Chili
10.	Mejellones, Chili	Iquique, Chili
11.	Iquique, Chili	Caleta Buena, Chili
12.	Caleta Buena, Chili	Panama, Canal Zone
13.	Panama, Canal Zone	Colon, Canal Zone
14.	Colon, Canal Zone	Baltimore, Md.
15.	Baltimore, Md.	Norfolk, Va.
16.	Norfolk, Va.	New York City
17.	New York City	Gulfport, Miss.

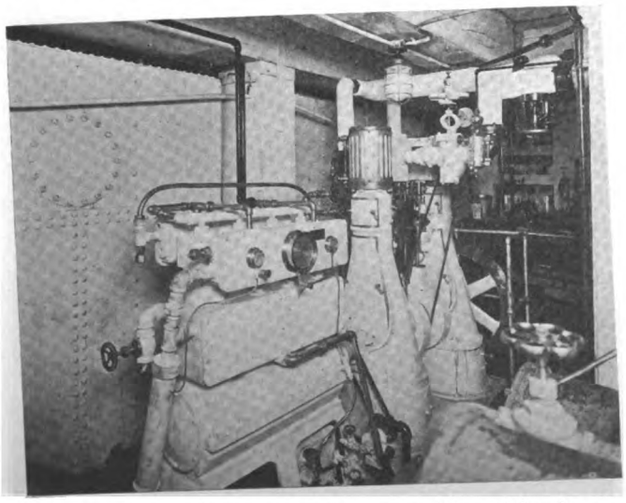

Fig. 6.—Winton Auxiliary Air Compressor Operated by Steam Engine

The lubrication oil consumption averaged about 14 gallons per day of 24 hours for both engines.

The steering of the *James Timpson* is taken care of by a Herzog electrical steering unit operated by a 1½-horsepower electric motor connected to the rudder stoc · by a reduction gear. It is operated by a small lever in the bridge deck in connection with a magnet. In approximately 20 seconds the vessel can be thrown from hard a-port to hard a-starboard.

It is interesting to compare the crew of the *James Timpson* with the crew of a steam-driven ship of the same approximate size and cargo capacity—approximately 3,000 tons:

Crew of the *James Timpson*	Crew of a 300-Foot Steamship—Coal-Burning
Captain	Captain
First mate	First mate
Second mate	Second mate
Third mate	Third mate
Chief engineer	Chief engineer
Three assistant engineers	Three assistant engineers
Three wipers	Three oilers
Two donkey boiler men	Six firemen
Wireless operator	Six coal passers
Boson	Wireless operator
Carpenter	Boson
Six sailors	Carpenter
Cook and three helpers	Six sailors
	Cook and five helpers
26 in all as a maximum	38 in all as a maximum.

Other interesting comparisons can be found in the difference in space occupied by the compact, light-weight Winton Diesel engines and the large, slow-turning steam engines; or the difference between the space occupied by

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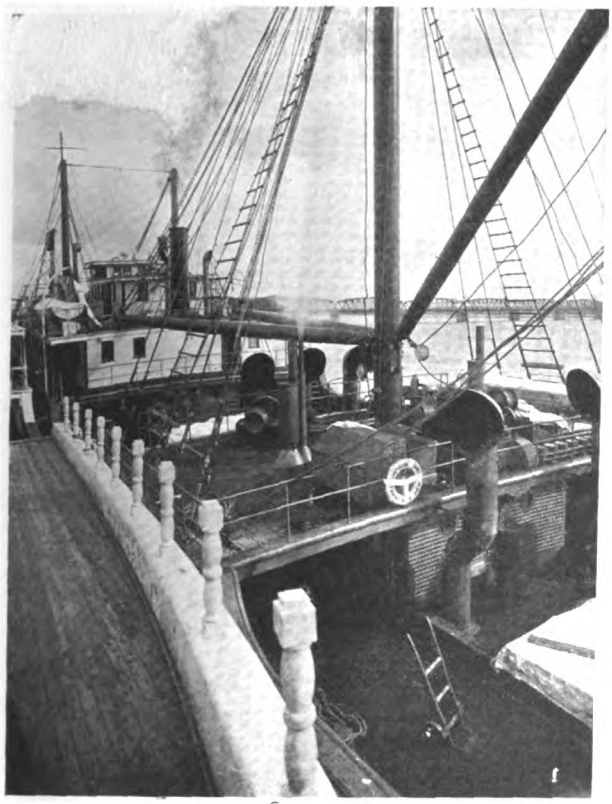

Fig. 8.—Deck Houses, Amidships

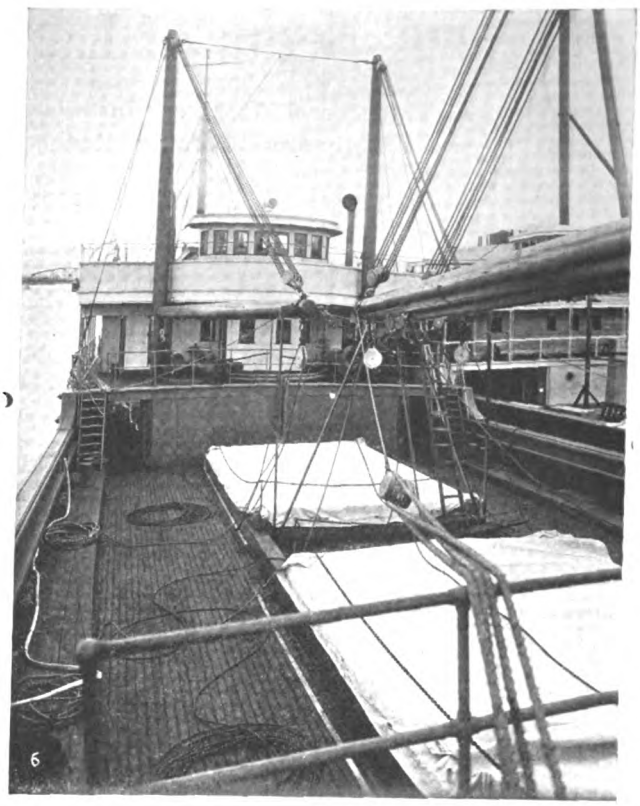

Fig. 10.—Main Deck, Looking Aft

the fuel oil in the *James Timpson* and the coal in the other type of ship; or the difference in time taken to take aboard fuel oil through a pipe or the slow process of coaling; or the fact that the *James Timpson* can take aboard enough fuel to go to Europe and back without re-fueling and still have enough oil on board to go back again, and the fact that her oil tanks are located in places which cannot be used for cargo space, thus giving another item of economy to an already long list. Hence the advantage gained in a vessel of the *James Timpson* type may be summed up briefly as maximum cargo capacity, minimum crew, quick fuel loading, hence no delays at port, highly efficient and economical power plant.

NOTE.—After this article had been written, the following telegram was received from Charles K. Wirosteck, chief engineer of the *James Timpson,* which recently left New York city for Gulfport, Miss.:

Editor of MARINE ENGINEERING:

"New record made with *James Timpson.* Run New York to Gulfport averaged 9¾ knots at 265 revolutions of engines. Ship light. Head wind two days, heavy sea. Made trip New York to Gulfport in 9 days 8 hours. Engines first class."

(Signed) CHARLES K. WIROSTECK.

This adds further emphasis to the fact that, despite this boat being powered with comparatively high-speed Diesel engines, and, in addition to this, being equipped with reduction gears, it has given excellent proof of its dependability and high efficiency.

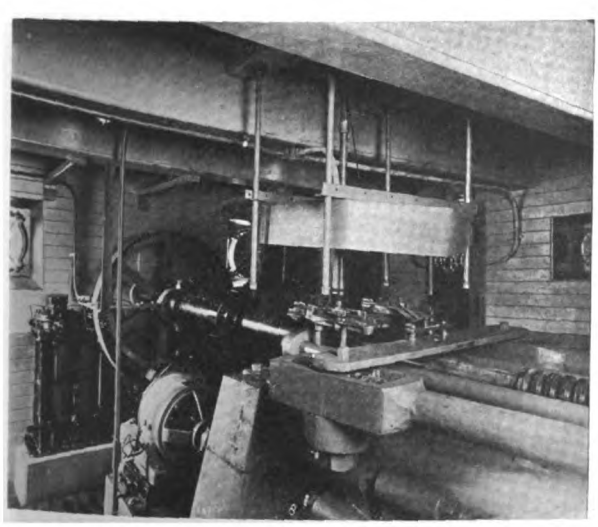

Fig. 9.—Herzog Electrical Steering Gear. Electric Motor Connected to Rudder Stack by Reduction Gear

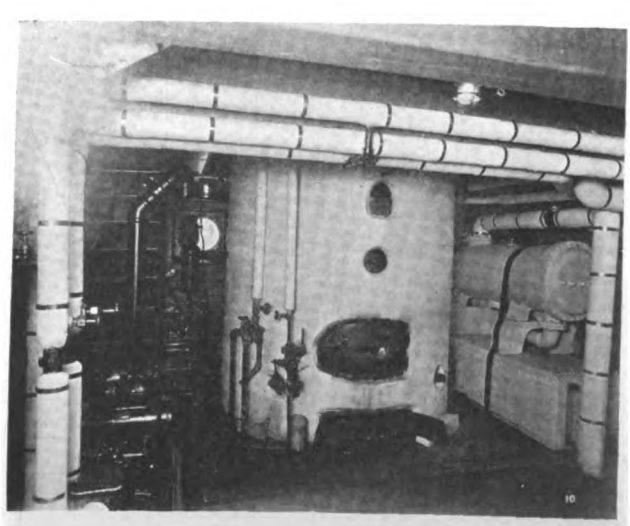

Fig. 11.—Oil-Fired Donkey Boiler with Condenser on Right and Bilge Pumps, etc., on Left

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Some Aspects of Large Diesel Cargo Ships

Steam and Diesel Machinery Installations Compared—Better Economy, Higher Speed and Greater Operating Radius for Diesel Ship of Same Displacement

BY H. R. SETZ*

OUR newly created fleet of cargo ships is to-day facing the task of entering the commercial field in competition against those nations who for years have been the carriers of the world's overseas commerce. In consequence of a natural course of development, as dictated by their increasing experience, these nations have established standards of practice which we shall have at least to equal, and, owing to our particular conditions, indeed, exceed, if we are successfully to meet this foreign competition.

The requirements imposed by this dictum are not the same which brought our cargo ships into existence. Under the pressure of the war emergency the principal requirement was rapidity of production, to which every other consideration had to be subordinated. To-day the principal consideration has become one of economy in the widest sense of the term; this imperatively demands substantial recognition of factors which, justly or unjustly, were passed by during the war period.

Diesel Engines Make for Economy in Operation

By far the most important single factor making for economy in the operation of cargo vessels to-day is the Diesel engine. This is being proven conclusively in the increasing number of large foreign Diesel ships now regularly plying to our shores, the clock-like regularity of their trips incidentally bearing evidence of their technical success as well.

The writer has recently had occasion to make a comparative study of the installation of a certain type of large Diesel engine in place of the steam equipment now actually used, and proposed for possible future use, on the 9,600 tons deadweight standard cargo boat of a prominent Atlantic coast yard. The results are of sufficient interest to justify publication of some of the most outstanding facts: being taken from actual practice, they clearly illustrate the possibilities of Diesel engines on large cargo ships.

Details of Steam Equipment

Figs. 3 and 4 show the layout of the equipment now used, consisting in its main units of three oil-fired Scotch boilers, each 15 feet 6 inches diameter by 12 feet long, one steam turbine developing 2,500 shaft horsepower at 3,600 revolutions per minute, and a double reduction gear driving the propeller shaft at 90 revolutions per minute. As indicated on the layout, the auxiliary equipment is very complete, duplicate sets being provided to ensure continuity of operation, such as auxiliary condenser, lubricating oil pumps, generating sets, etc.

The weight of this equipment complete, including boiler uptakes, stack and induced draft system, circulating pumps and all the small auxiliaries shown, amounts to 550 tons. The engine and boiler rooms are located amidships, covering a space extending about 50 feet in length. This, it will be noticed, does not include any deep tanks to carry boiler feed water or fuel oil. Under normal operating condition, the vessel traveling at its fully loaded sea speed of 11 knots, the fuel consumption of this installation, including auxiliaries, runs in the neighborhood of 30 tons per 24 hours.

Figs. 5 and 6 show the power plant layout for the same vessel driven by a triple-expansion steam engine instead of the turbine reduction gear set, the experiences had with the latter giving sufficient cause for anxiety to suggest such a change as a future possibility. The boiler end of the installation remains the same, whereas the engine room auxiliaries change somewhat in conformity with the particular features of the main engine. The complete

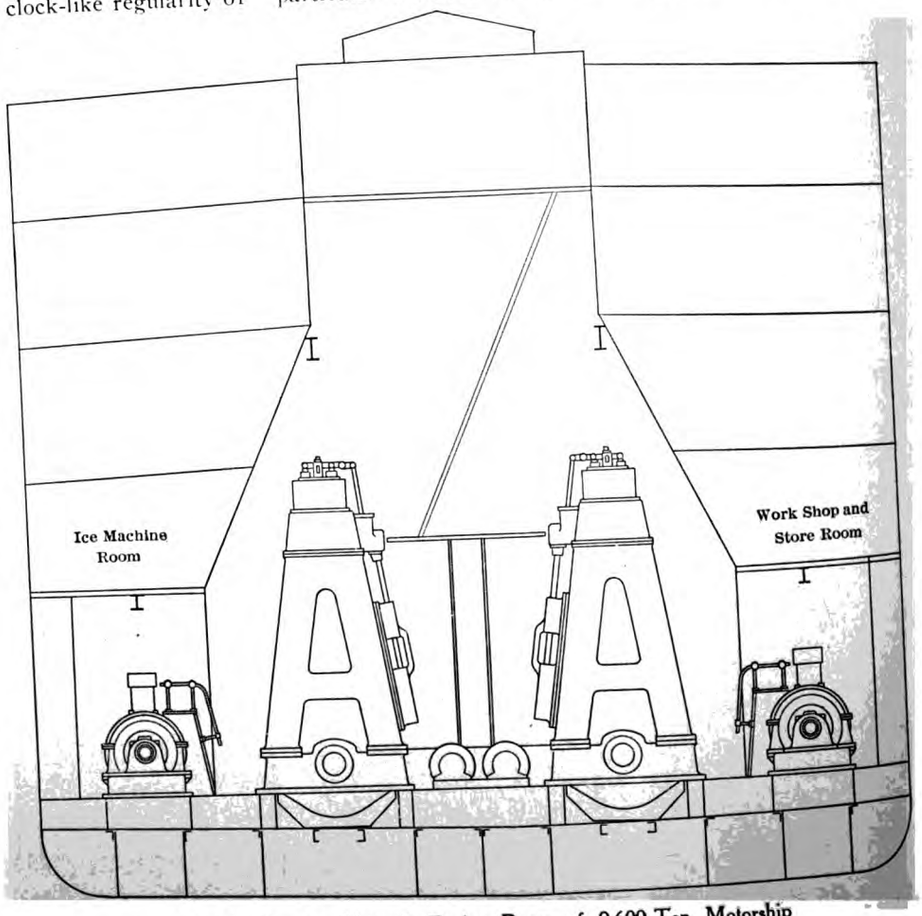

Fig. 1.—Section Through Engine Room of 9,600-Ton Motorship

*Consulting engineer, New York.

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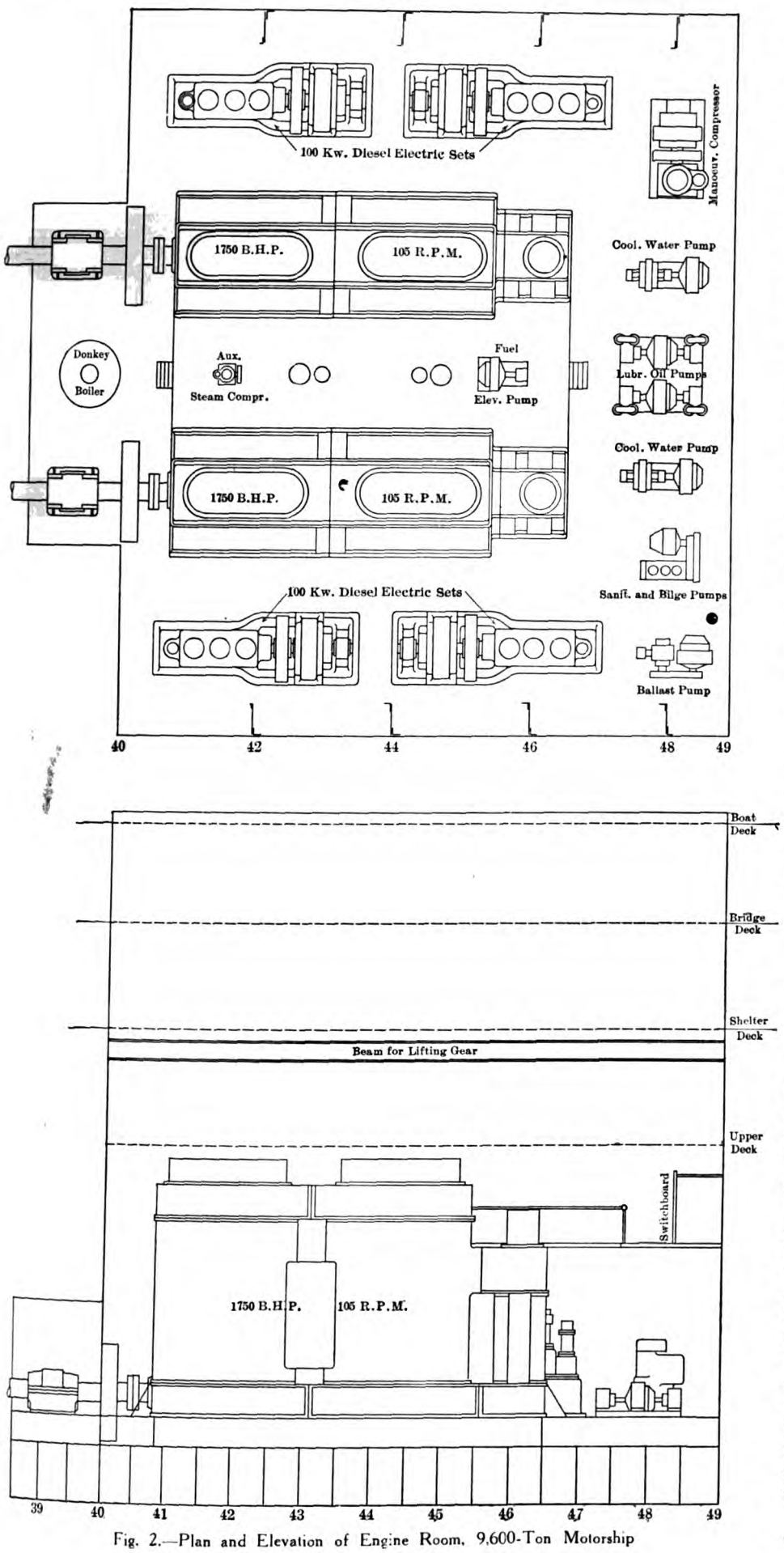

Fig. 2.—Plan and Elevation of Engine Room, 9,600-Ton Motorship

equipment, however, will go in the same space as the geared turbine set, while the weight will increase to 610 tons. The fuel consumption of this installation would hardly be less than 35 tons per 24 hours.

Attention is called to the fact that the fuel consumptions given for the turbine or triple-expansion engine respectively are those corresponding to the best possible operating conditions of the whole installation. The average results obtained on a long voyage are likely to be higher, owing to the variable contingencies of operation (weather, load, plant conditions, etc.), all of which make the maintenance of an even and high economy, even of an oil-fired steam plant, difficult and demand close personal attention. In other words, the personal element enters so decidedly into the economy question, and is such a variable quantity, that the figures given above are merely representative of what is within possible reach but is likely to be exceeded.

Corresponding Diesel Installation

Figs. 1 and 2 show the layout of the proposed Diesel engine installation. This, in accordance with the most approved modern practice, consists of two main units, each driving its propeller at a speed of 105 revolutions per minute. Owing to commercial considerations it would be desirable to increase the speed of this vessel from its 11 knots under steam power to at least 12 knots, if within the limits of Diesel engines. The Diesel engines, therefore, will have to develop 1,750 shaft horsepower each, which is considerably below the power that to-day is the largest practical output of engines of this type.

This combined capacity of 3,500 shaft horsepower

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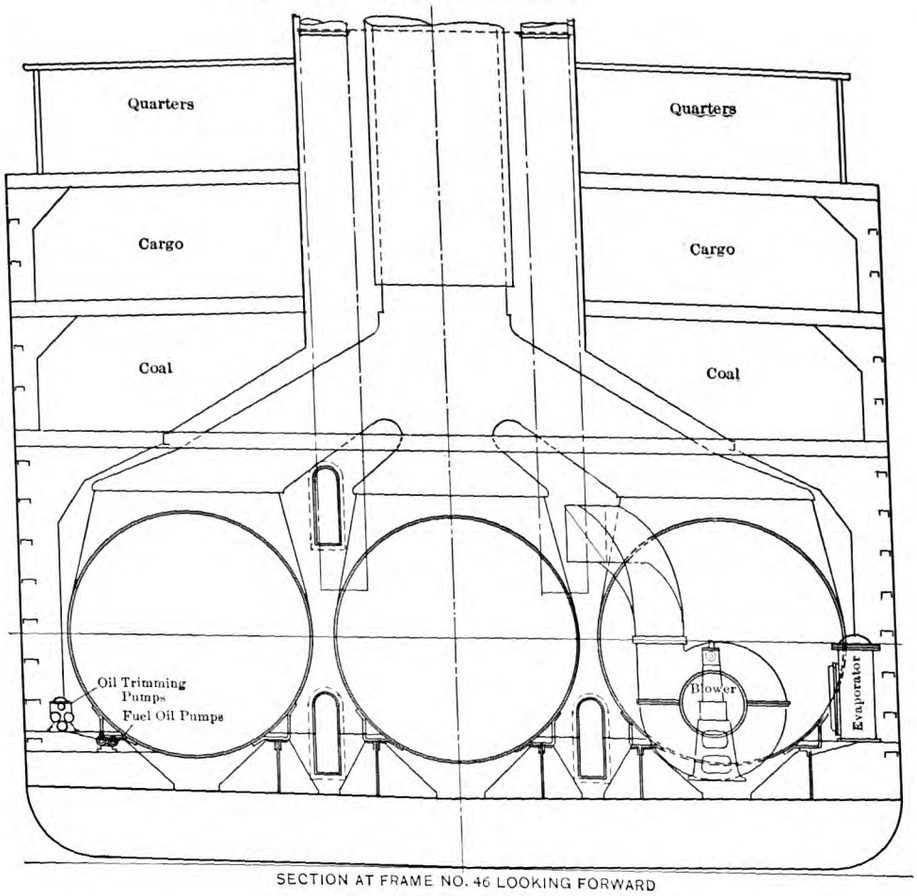

Fig. 3.—Sections Through Boiler and Engine Rooms of 9,600-Ton Turbine-Driven Cargo Steamer

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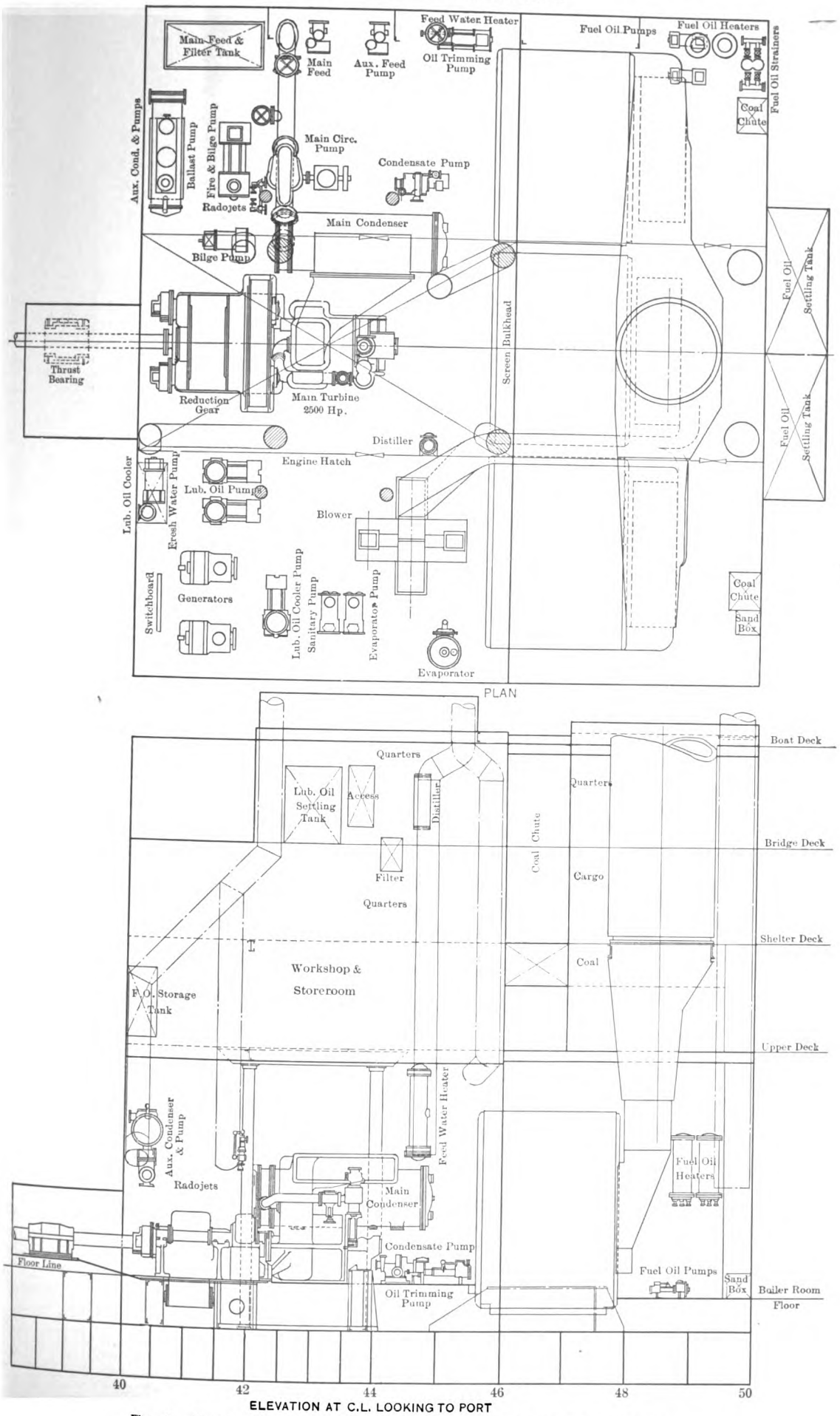

Fig. 4.—Machinery Arrangement of 9,600-Ton Turbine-Driven Cargo Steamer

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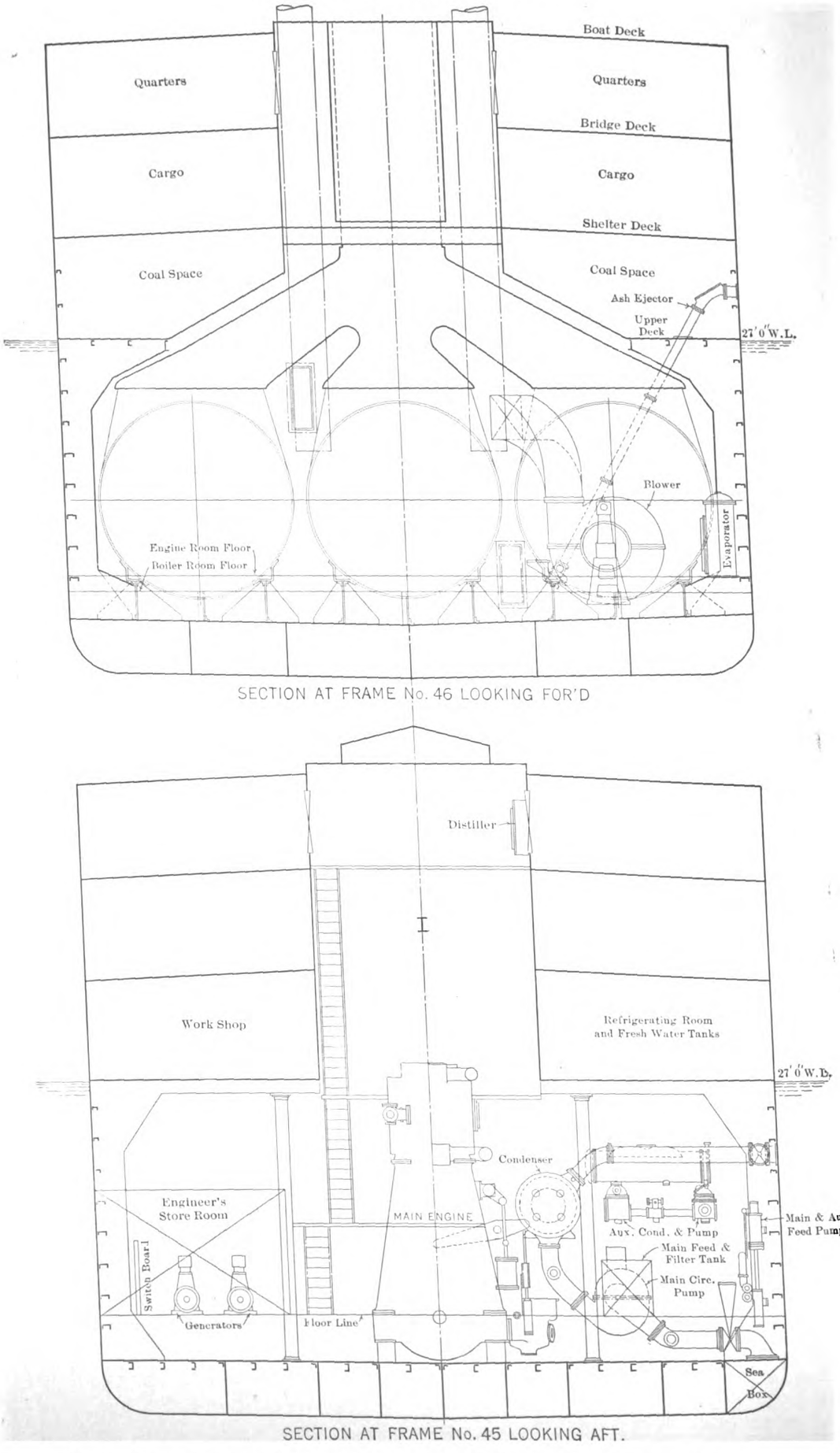

Fig. 5.—Sections Through Boiler and Engine Rooms of 9,600-Ton Cargo Steamer Driven by Reciprocating Engine

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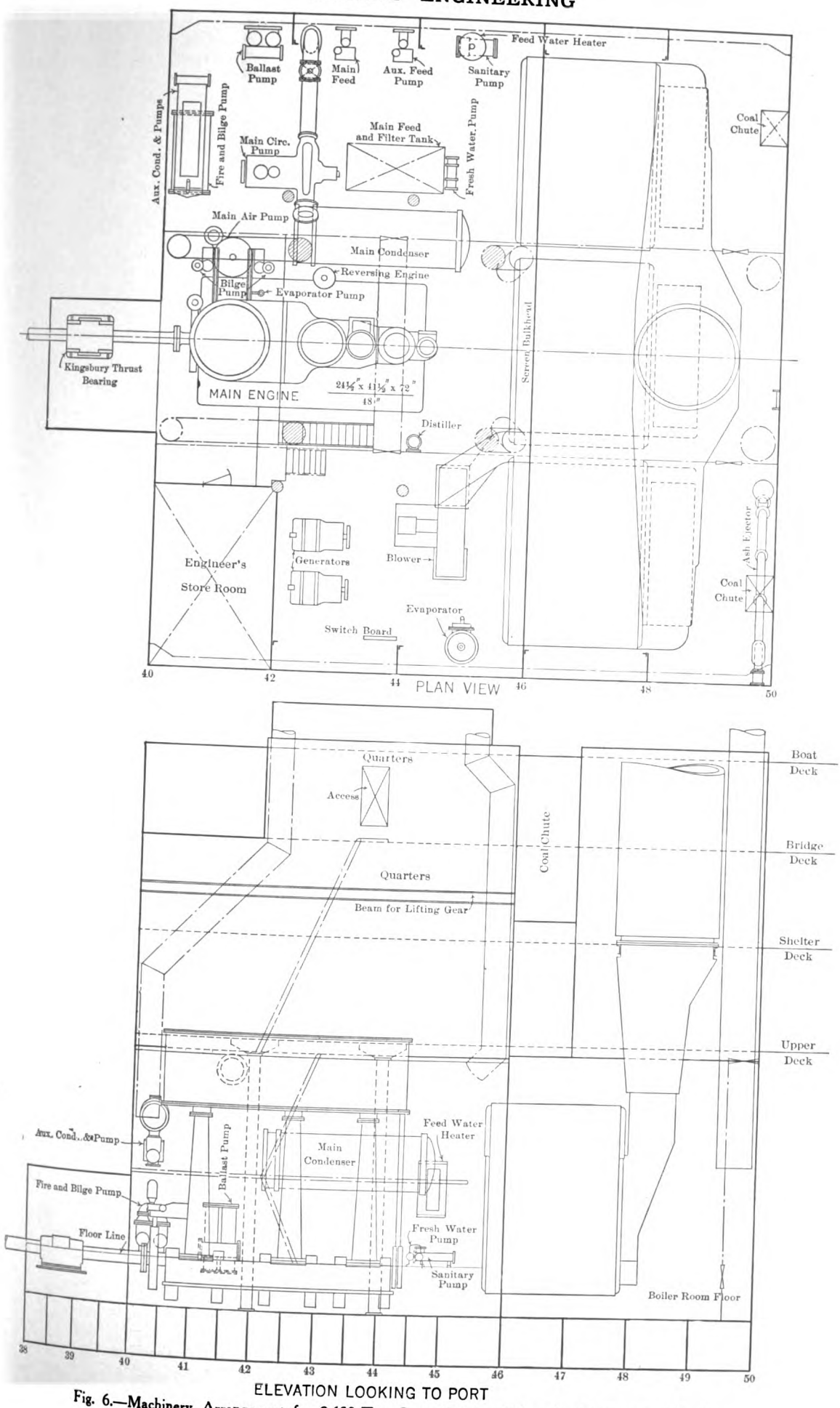

Fig. 6.—Machinery Arrangement for 9,600-Ton Cargo Steamer Driven by Reciprocating Engine

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is somewhat in excess of the ideal requirements, 3,150 shaft horsepower, and therefore easily ensures the maintenance of 12 knots sea speed even under most unfavorable service conditions, especially since these engines have the usual overload margin.

Outside of the two main engines, the equipment consists of four 100-kilowatt, 3-cylinder Diesel electric sets running at 300 revolutions per minute each. This rather liberal supply of auxiliary power is provided so as to be able to make use of electrically driven auxiliaries throughout the ship, including the cargo hoists, windlass and steering gear, i. e., all the deck machinery, as well as the auxiliaries required in the engine room.

The auxiliaries in the engine room consist of a double set of lubricating oil circulating pumps, of whch two are always driven by one motor, two centrifugal cooling water pumps, one sanitary and bilge pump, one ballast pump and one fuel elevating pump. The motors required for these pumps vary in capacity from 5 to 25 horsepower. There is, furthermore, provided a two-stage maneuvering compressor driven by a 60-horsepower motor. The uniformity and simplicity of this auxiliary equipment is worth noting in comparison with the diversified apparatus that goes with a steam installation.

An oil-fired donkey boiler of about 100 square feet heating surface, located in the thrust recess between the two main engines, supplies steam for heating purposes and to the small auxiliary steam compressor. Between the main engines are located the injection air receivers, while the two main starting air tanks, kept charged under 300 pounds pressure, are located forward of the storeroom, immediately under the upper deck. It may be mentioned that, owing to the method of starting incorporated in this particular engine, the use of starting air is extremely economical, requiring less than half the usual air receiver capacity; for this reason the maneuvering air compressor can also be made considerably smaller than is customary.

The exhaust from the main and auxiliary engines will be run in separate pipes up the after engine room bulkhead to suitable silencers located in a small silencer house on the boat deck; this leaves only short runs of straight piping in the engine room, which by liberal water cooling and lagging can be insulated to prevent excessive heat radiation, thus obviating the necessity of special fans. The very effective air circulation caused by the suction of the engines, of course, further aids in keeping the engine room temperature down.

Weight of Diesel Equipment

The weight of the two main engines complete with all necessary piping and air receivers is 420 tons. The auxiliaries complete as shown will weigh from 150 to 160 tons, making the maximum weight of the complete installation 580 tons, or 370 pounds per main engine shaft horsepower, as compared to 490 pounds of the steam turbine reduction gear installation and 545 pounds with a triple-expansion engine.

In spite of the 1,000 horsepower additional capacity of the Diesel installation, as compared with the steam equipment, the compactness of the former is striking. Without in the least crowding the various units together, it is possible to locate the main engines and all auxiliaries in an engine room only 45 feet long overall. The gain in cargo space thus effected amounts to 8,200 cubic feet, or equivalent to slightly over 2 percent cargo ton capacity. (Steam equipment to the same aggregate capacity as the main Diesel engine could not be installed in a space less than 70 feet long, reducing the cubic capacity of the boat by over 30,000 cubic feet. To this should be added an increase in weight of machinery amounting to 30 to 35 percent over the figures given above.) This remarkable compactness of the Diesel engine, more or less a feature of all makes now in successful use, is particularly pronounced with the type under consideration, owing to its careful design and admirable simplicity and directness of application of the most advanced principles of marine engine construction.

Fuel Consumption

Under regular service conditions, with the boat fully loaded and traveling at a speed of 12 knots, the fuel consumption of the main engines (including auxiliaries) will not exceed 15½ tons per 24-hour day. With a storage capacity in the double bottoms, all of which is used for carrying fuel oil, except a lubricating oil tank of some 10 tons capacity, close to 1,100 tons, this will permit the ship easily to operate at its normal speed for a period of 65 days, allowing about 100 tons of fuel as stand-by for emergencies and reserve for loading and unloading while in ports away from a favorable fuel supply. The loading and unloading operations, together with other power required while in port, will consume not over ¾ ton of fuel per day.

Comparing this with the steam equipments, making the same proportionate allowance for a reserve supply, although the fuel consumed while in port will easily amount to 3 tons per day, the available fuel will be sufficient for just 30 days' traveling with the turbine-driven boat, and 26 days when using the triple-expansion steam engine. Reduced to steaming radius, owing to the difference in speed between the two vessels, the turbine steamer will be able to cover 42 percent and the reciprocating engine driven ship barely 37 percent of the distance possible with the Diesel ship, in spite of the latter's higher speed, which necessitates using 40 percent more power than the steamers.

The steamship owner thus faces the alternative of having to operate over shorter and rather selected routes, so as to permit of more frequent refuelling, or else to carry an additional fuel supply in the hold at the expense of valuable cargo space. In the cases in question, in order to equal the performance of the Diesel boat, the extra weight carried would have to be not less than 1,250 tons in the turbine ship and 1,400 tons with the triple-expansion engine, which is equivalent to 13 and 14½ percent respectively of the total capacity of the vessel.

Account should next be taken of the supply of fresh boiler feed water, which with either type of steamer amounts to not less than 150 tons, whereas for the donkey boiler of the Diesel ship 35 tons is sufficient; the difference of 115 tons may, however, be considered equalized by the extra shaft tunnel and the tunnel tank of the Diesel ship.

Allowance should furthermore be made for the smaller engine room crew required by the Diesel ship, which, even if it should not materially reduce the payroll, means at least smaller quarters and less supplies, and therefore a corresponding increase in cargo space.

Summary of Advantages Gained in Diesel Ship

Summarizing, we thus find that the displacement of the respective boats being the same, the complete machinery of the Diesel ship weighs approximately the same, although its speed is 9 percent greater than that of the steamers. With the same tonnage of cargo and initial fuel supply, the Diesel ship will have a 240 percent greater operating radius than the turbine boat and 270 percent greater radius than the reciprocating engine driven boat. Conversely, for the same radius of operation, the steamers could carry only 87 percent and 85½ percent respectively of the cargo which the Diesel ship can handle, to which should be added the increased revenue capacity of

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the latter resulting from the greater distance which its higher speed permits it to cover in one year's operation.

These pronounced superior advantages in fuel economy, cargo weight and space capacity and radius of operation result in returns which, applied on a common percentage basis, are equivalent to the interest of a much larger capital than that invested in a steamer of the same displacement. Under existing market conditions for material and labor, this permits the valuation of a motorship to be set from 20 to 22 percent higher than that of the steamer after allowance for the higher cost of the Diesel equipment has been made. This figure is, of course, subject to improvement as the rate of production of Diesel ships increases, but even as it is it shows a way to absorb quite a material percentage of the higher cost of production of our ships as compared to that of foreign-built vessels. Moreover, owing to the use of a smaller engine room crew, as well as owing to the maintenance of a uniformly high economy independent of the personal element, which is a typical feature of Diesel engines, their installation on American cargo ships will bring the cost of operation more nearly to the same level as that of our foreign competitors.

These are features which should be taken advantage of to the fullest possible extent in order to bring into existence an American merchant fleet of real economic capacity. The use of Diesel engines on large cargo ships is to be particularly invited. Outside of the comparatively short voyages to Europe, the principal lanes of travel of our merchant fleet will be the much longer distances down the east coast of South America and especially to the Orient, where China and Siberia alone are potential markets far more important for the United States than all the others combined. These are countries comparatively far removed from natural supplies of oil, and to negotiate these long voyages economically it is imperative that our vessels be propelled by machinery which does not require inconvenient stops or extra trips for refuelling. The Diesel engine is singularly well adapted for these particular routes, and its adoption is the *one* move whereby an American merchant marine can assert itself.

This is as important a consideration to shipowners as to shipbuilders. Now is the time, as long as our merchant fleet is still in the formative stage, to catch up with and exceed the pace already set by users and builders of motorships in Europe.

Based upon the foregoing figures, and assuming a mileage for the average round trip to the Orient of 14,000 nautical miles, the savings effected by the lower fuel consumption and corresponding increase in cargo-carrying capacity, as well as by the higher sea speed of the Diesel ship, arrange themselves as follows:

	Diesel Ship	Steamer	
		Turbine	Engine
Duration average round trip, days	49	54	54
Days in port	24	24	24
Number of round trips per year	5	4.6	4.6
Fuel consumption per round trip, including days in port, tons	780	1,620	1,890
Excess fuel consumption over Diesel ship, tons		840	1,110
Excess fuel cost over Diesel ship, fuel at $16.50 per ton		$13,860	$18,315
Decreased cargo revenue compared to Diesel ship, cargo ton at $15		$18,900	$24,975
Total discrepancy per year		$150,700	$199,100
Additional revenue of Diesel ship, owing to higher speed, equivalent to 7,500 tons more cargo carried per year	$107,900		
Excess annual earnings of Diesel ship over steamers	$258,600 (over turbine ship); $307,000 (over reciprocating engined ship)		

In the above figures the difference in other operating items such as wages and food for the engine room crew, lubricating oil, etc., are not included: aside from being relatively insignificant compared to the tabulated figures, a saving in one direction with Diesel engines (smaller engine room crew) is offset by a saving in the other direction with the steam plant (lower lubricating oil consumption), the relative differences of these items, while slightly in favor of the Diesel engine, not being of sufficient importance to be worth considering here. The important point is to focus attention on the tabulated items, and particularly on the substantial gain in revenue capacity of the Diesel ship due to its higher speed, which adds 54 and 71 percent respectively to the increased earnings resulting from the lower fuel consumption. This gain is particularly significant if it is remembered that the complete Diesel equipment with which this higher speed is attained can be installed in a smaller space than that of either steam plant; the resulting gain in cargo space, which with cargo classified by cubic measurement for its tonnage will amount to another substantial increase in revenue, is not even included in the tabulated figures.

The exposition just issued by the Department of Operations of the United States Shipping Board regarding future shipbuilding invites careful contemplation upon this feature of space and weight requirement of the propelling machinery, since some of the new types of ships are recommended to be driven by quadruple expansion steam engines at a sea speed of 13 knots. Outside of technical objections which give rise to some doubt as to the advisability of using such engines in this particular application, their bulk and weight, in addition to the great quantity of fuel these boats will have to carry for the specified steaming radius even in spite of their improved economy (about on a par with that given above for the turbine), will impose enormous commercial disadvantages.

Compared to a twin-screw Diesel installation of similar combined capacity, these disadvantages are so pronounced that it would be little short of a calamity to undertake construction of such steamers on an appreciable scale at so late a date. Even if such action should suggest itself by the possibility of production on a somewhat quickened schedule, this advantage is of so momentary a nature that it fades into insignificance in relation to the broad issue of bringing into existence an economical American merchant marine. From the viewpoint of national expediency, the early and unprejudiced recognition of the Diesel engine in the various forms in which it has proved to be feasible is the only path open whereby to reach our goal.

Fortified with a mass of valuable experiences which extend back over almost ten years of practical marine work, we are to-day in a position to build Diesel engines without any question as to their technical success. Problems pertaining to design and construction are so well understood that it is easily within the capacity of properly informed specialists to meet almost any requirement. What we need now is actually to embark upon the application of this accumulated knowledge in American shops, under conditions which are conducive to the same concentration and continuity of development that has led to the high stage of perfection in Europe. This is a perfectly natural process of evolution which involves no secrets, but likewise permits no short cuts.

Considering the sizes of engines that will be needed, however, and the expense involved in their development, it cannot be reasonably expected that the few private enterprises which by location, equipment and organization could to-day do such work justice take the initiative without some tangible encouragement. It is up to the Shipping Board to inaugurate such activity, and that on a comprehensive plan which will ensure a healthy develop-

(*Concluded on page 250.*)

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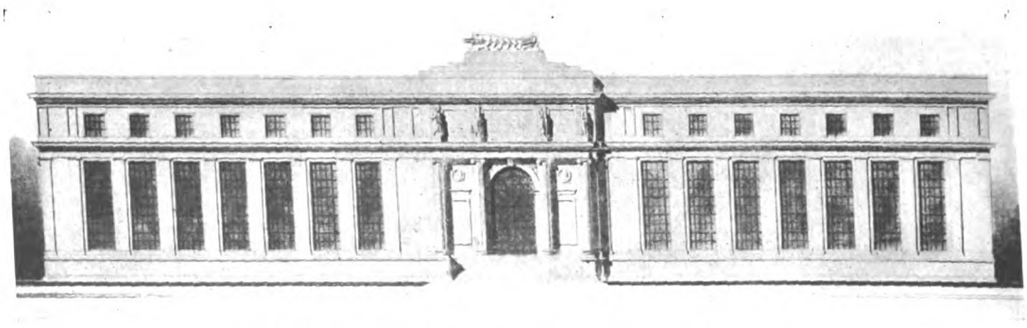


Architect's Drawing of the Pratt School of Naval Architecture

Pratt School of Naval Architecture

Work of the Department of Naval Architecture and Marine Engineering at the Massachusetts Institute of Technology

BY PROFESSOR C. H. PEABODY*

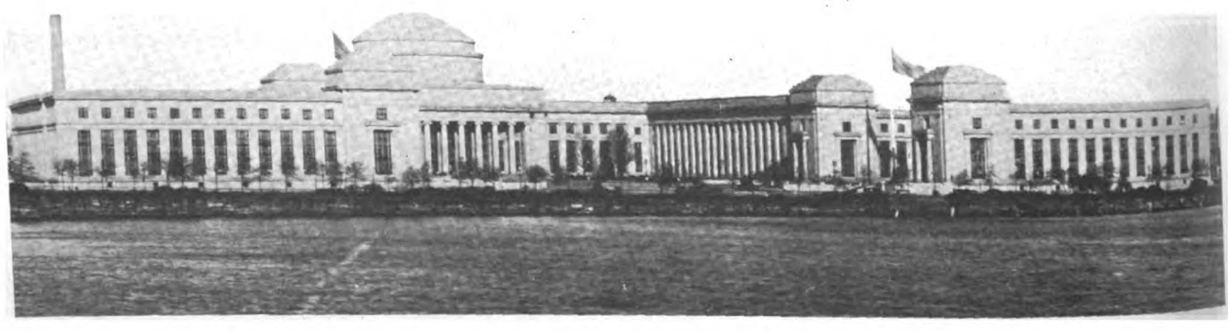
IN 1893 the Massachusetts Institute of Technology, Boston, Mass., offered a course of instruction in naval architecture and marine engineering, graduating the first class in 1895. The number graduated from that regular course with the degree of Bachelor of Science has reached a total of 222. In 1900 the United States Navy Department selected the Institute to give a special course to officers designated for the Corps of Naval Constructors; seventy-eight constructors have been graduated with the degree of Master of Science. Upon the declaration of a state of war in 1917, a short course in naval architecture for technical graduates, and teaching only naval architecture and ship design, was offered. Three other such short courses have been given, with a total membership of eighty-five. Such, in brief, has been the service of the Department to the nation, and, in large part, toward the prosecution of the great war.

There is a certain inevitable resemblance of all technical schools and colleges wherever located in America or in foreign lands, and especially of all courses in naval architecture; there must be certain fundamental preparation in mathematics and natural service, and certain subjects of instruction and methods of construction and design must be presented. There is a tendency at present to offer at technical schools a variety of courses of engineering; some are well known, such as civil, mechanical and electrical engineering, others are newer or more special, like sanitary engineering or gas engine engineering; but all are primarily engineering and are likely to show marked divergencies only in the later years of the course. Naval architecture harks back to the time of wooden ships, when the ship carpenter was brother to the house carpenter; but now the shipbuilder is an engineer with affiliations with the bridge builder and the boiler maker, and must work in conjunction with the marine engineer. In consequence of this condition, the first two years of the course in naval architecture and marine engineering at the Massachusetts Institute of Technology are scarcely differentiated from general engineering; in the second year of the course, instruction is given in ship construction and in ship drafting, in order that students may have the advantage of working in a small department where they become well known personally and to enable them to use their summers advantageously.

Vacation Work in the Shipyards

For many years the Institute has had a general understanding with the shipyards of the Atlantic Coast by virtue of which students in the vacations following the sophomore and junior years work in either the yard or the engine shop, or in both. All students desiring such work have had opportunity, and most have taken advantage of it. Though a naval architect cannot know too

* Head of Department of Naval Architecture, Massachusetts Institute of Technology, Cambridge, Mass.



View of the Massachusetts Institute of Technology from the Charles River Embankment

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much of the details of ship construction or operation, the chief advantage of such an experience is that the student becomes familiar with the conditions of shipbuilding and can better appreciate both theoretical instruction and practical design and construction. He learns to think in terms of ships. Again, he works with the men who build the ships and learns to understand human nature.

As the third and fourth years progress, the student gives more attention to the theory of naval architecture, including the methods of computing displacement and stability, the study of waves and the rolling of ships, and also of the devices for controlling the rolling, the determination of power required for propulsion and of methods of applying the power, and, finally, the consideration of the stresses likely to be set up in the structure of the ship when at sea. Each student makes a design of a ship in sufficient detail to insure that he learns the methods of construction and arrangement and all the usual computations of displacement, stability and strength; computations for launchings are also made.

Model Making

Each student makes a model of the hull of his ship, on which he lays out the plating and from which he prepares an order sheet. Incidentally, he gains an idea of form and learns to interpret his ship lines. The Department has a well-equipped wood-working shop with saws and planes for preparing materials for models, so that the students' work can be precise and expeditious.

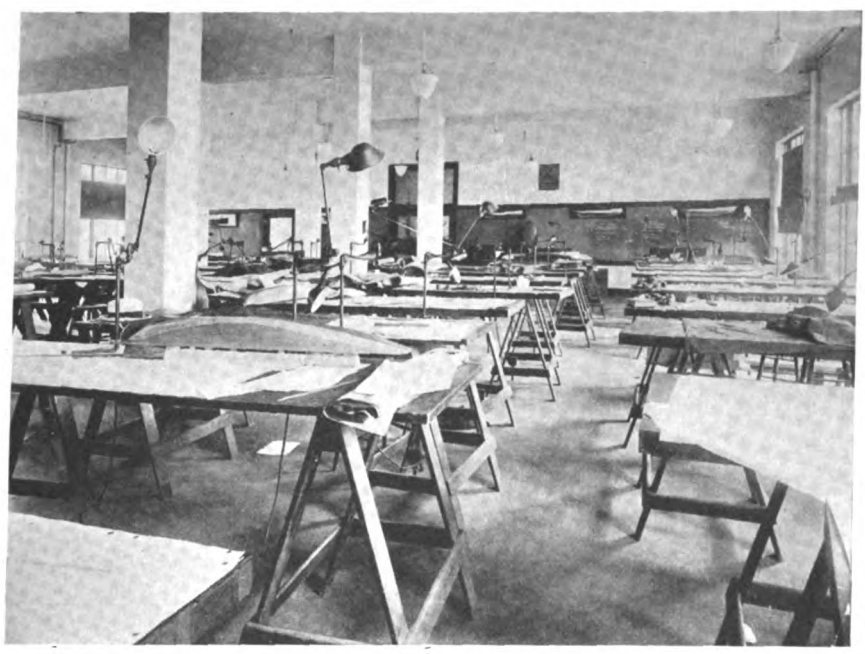
The Department has a set of glass-topped tables for fairing lines to a large scale and has been in the habit of giving instruction in mold loft work at the end of the junior year. This provides a means for the practical application of the theoretical knowledge gained in the class rooms.

Little has been said as yet about marine engineering, which can be separated only with difficulty from naval architecture. In practice, the engines and their arrangement and the propellers are cared for by the marine engineer; but the student must treat the subject of propellers in connection with propulsion, which has much to do with the determination of the forms of the ships. Formal instruction in marine engines, including steam turbines, is given in the senior year, at which time the student makes a preliminary design of the engine and its arrangement and considers the probable stresses in the frame and moving parts as affected by steam pressure and dynamic action. So much concession is made to custom as to make the drawing of the propeller a part of marine engineering, even though the design is made in connection with naval architecture.

Since the naval architect must provide a location for the compass and should understand conditions required to avoid undesirable deviations, the Department has a standard compass and binnacle and a pelorus, which are used to teach compass adjustment.

Naval Constructor's Course

As already said, officers designated for the corps of naval constructors, after graduating from Annapolis and a year or two of sea experience, are selected for scholastic ability and general character and come to Technology for a three-year course, covering the junior and senior years and a graduate year; on graduation, they receive the degree of Master of Science. The instruction in theoretical naval architecture is the same as that of the regular course, but with more time at command they have longer and more detailed training in ship design and construction commensurate with the difficulty of meeting the demands that a warship shall combine great gun-power, speed and protection with the least possible displacement. The course, like the regular course, includes marine engines and turbines and also electrical engineering, aeronautical engineering and methods of accounting. Considering the maturity of the officers, the methods of selection and their zeal in their profession, it is fair to say that few candidates for the master's degree come with so high a standard of ability and achievement.



Drafting Room in the Department of Naval Architecture

Speed and Economy Trials of Vessels

The favorable location of Technology enables students to visit ships, shipyards and engine works in connection with their studies. Many speed and economy tests of ships of various importance have been made by students of the Institute in preparation of their graduation theses. Notable among them were the tests of the Coast Guard ship *Manning* and the destroyer *Sterret*. The course in naval construction just described is restricted to officers of the Navy, but a parallel course giving substantially the equivalent is maintained which is open to all students, whether they are Americans or citizens of other countries.

In 1915, the Institute offered a graduate course in aeronautical engineering leading to the degree of Master of Science, attached to the Department of Naval Architecture. From this course there are ten graduates, of whom five were detailed from the Signal Corps of the Army.

Aeronautical Engineering

A four-foot wind tunnel, modeled after one in the National Physical Laboratory at South Kensington, was installed when the course opened; it is expected that a seven

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foot tunnel will be built in the near future. Our tunnel has been under contract to the Army since the declaration of war with the central powers. Immediately after that declaration, two ground schools of aviation were established at the Institute—one for the Army on May 21, 1917, and the other for the Navy on July 23, 1917. In connection with the latter there was established a school for airplane inspectors October 1, 1917. The Institute has perhaps made its most notable contribution to aeronautical engineering by carrying through two classes of officers of the Army and Navy who had already become pilots. The first class numbered thirty beginning March, 1918, and ending September, 1918; the second class began September 30 and ended January 25, 1919, numbering fifty-six. Officers having adequate training in engineering were selected for these classes.

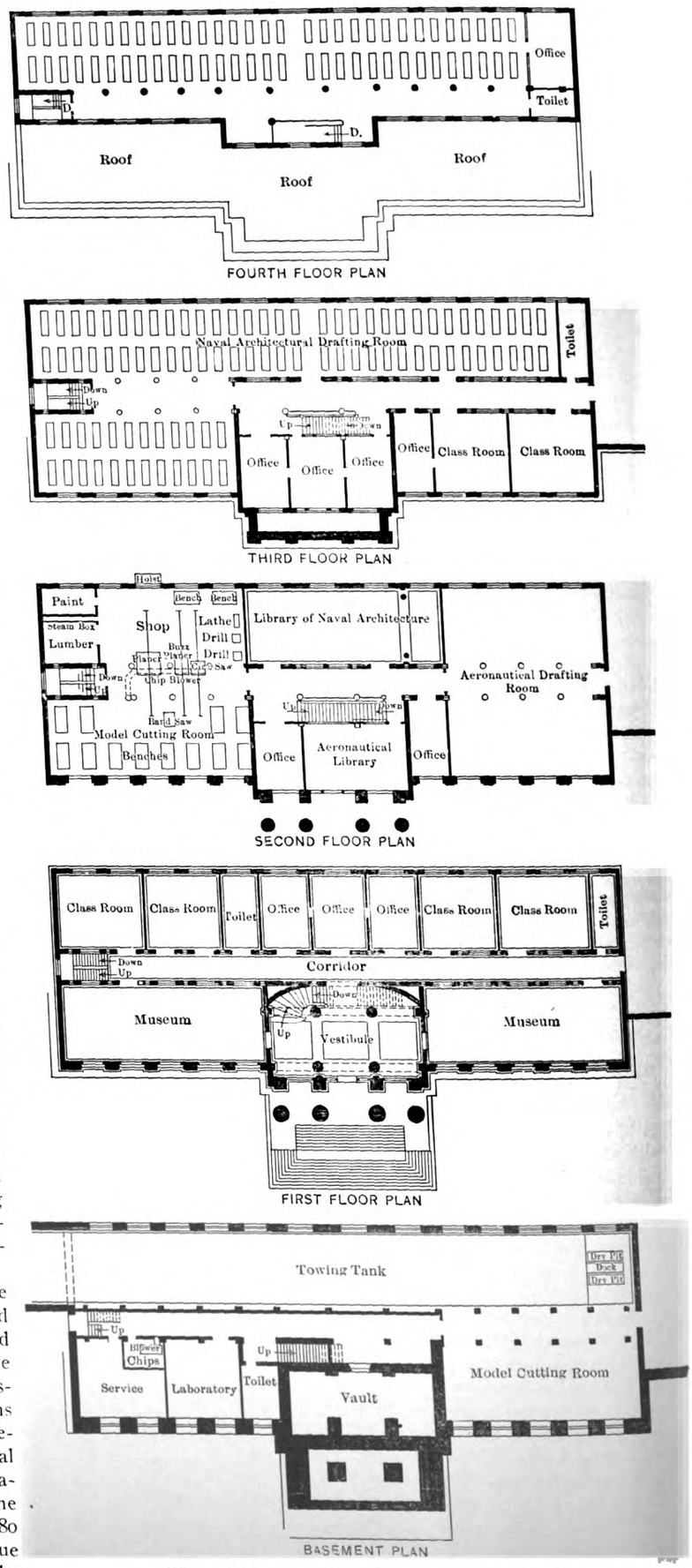
However legitimate and desirable may be the association of aeronautical engineering with naval architecture, this is hardly the place for a detailed description of our course. It is likely that an undergraduate course will be offered soon.

Fortunately, the regular service of the Department of Naval Architecture has not been interrupted by the war, though somewhat dislocated; thus the senior class of 1917 was graduated in April, while the class of 1919 was graduated in September, 1918; but next year the Department will be on its normal peace footing and able to care for all who come.

The Pratt School of Naval Architecture

In 1912, Mr. C. H. Pratt, of Boston, left his estate to the Institute, with the proviso that there should be erected a memorial building to his father and himself, to be known as the Pratt School of Naval Architecture and Marine Engineering, and that the remainder of the estate should be used as a permanent endowment of the Department. At the present time the estate is in the hands of the Corporation of the Institute and is valued at a million dollars. This benefaction ensures an adequate course in naval architecture and marine engineering at Technology, and also a course in aeronautical engineering in connection therewith.

Some years elapsed before the Institute could complete all legal requirements and obtain full control of the Pratt fund, and then the war delayed building because the priority commission could not grant permission for the requisite material. Now plans are ready and there will be no further delay in the erection of a suitable memorial building. This building will face on Massachusetts avenue adjoining the wing of the main building on that avenue. It will be 180 feet long, three stories high on the avenue to conform with the general plan of the



Plans of the New Pratt School of Naval Architecture

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Technology buildings; it will have four stories at the rear, the fourth story not showing above the parapet on the street.

In the Pratt building there will be adequate accommodation for the Department of Naval Architecture and Marine Engineering, including the course in naval construction and the course in aeronautical engineering, with provision for normal development. There will be large well-lighted drawing rooms, many lecture rooms and necessary offices. There will be a convenient room for cutting ship models equipped with proper machines. This shop can be used also for making aeronautical models for the wind tunnels. The tunnels themselves will be accommodated in another building.

Provision is made for two museums, one of naval architecture and one of aeronautics, to preserve notable material and to give examples of construction.

The question of providing a tank or model basin is yet under advisement; provision can be made for housing the inner end of the tank and all its appurtenances in the Pratt building, but the great length required for the tunnel would carry it through the next building and beyond, the next building belonging as yet to the future. Of course the tank, if so located, could be completed without waiting for the erection of a future building that might easily be erected over it. The plans of the Pratt building are shown on these pages. These plans will be followed substantially as given, with perhaps minor changes.

The Education and Training of a Naval Architect

Courses Designed to Give Broad Outlook Upon the Whole Field—College Curriculum Combined with Practical Work—Development of Designing Originality

BY LAWRENCE B. CHAPMAN*

THE present revival in shipbuilding in this country, together with the fact that keen competition will exist in shipbuilding and shipping among the nations, will create a demand for men rigorously trained in naval architecture. During the last few years the American merchant marine had sunk to the nadir of its existence, and, as the demand for men technically trained in naval architecture has been small, the proper attention has not been given to the education of men in this field. The men which the technical schools have produced in the past are not of the type that the future will demand. It is for this reason that I am prompted to place my studies and views before the engineering public.

EFFICIENT OPERATION WILL ELIMINATE HANDICAP

The course of training that I shall present is rather a departure from the accepted courses as given in this country. We should bear in mind, however, that this country is just entering the field of maritime commerce, in which other nations are well established. At the outset we are hampered by labor conditions and seamen's laws that put us at a disadvantage with our competitors. For us to compete successfully with them under these conditions, it is necessary that we design more efficient ships and build and operate them in a more efficient manner. Moreover, due to the greater difficulty of accomplishing improvements in the field of naval architecture to-day, as compared with the last century, the future will call for higher ability than has been exercised in the past. The men who are to carry out this work must be trained in the broadest and most rigid manner.

It is assumed in this article that the student is training for a professional status in naval architecture. Some of the men who complete the course will eventually drift into allied fields, and others will give up the career of a naval architect for one in some other branch of engineering. This fact, however, is given no weight in the following discussion.

The first essential requirement for a course of training in naval architecture, as well as in any branch of engineering, is that only those who have the proper aptitude should be encouraged to pursue it. The student should show by his boyhood activities and interests that he has a natural bent for the calling; he should have a clear conception of the nature of the duties that one in this line will be called upon to perform; and he should be fitted by ability and mental caliber for the work required in the engineering profession. In short, he should feel that he is claimed by the field of naval architecture and not choose the work blindly or in a haphazard manner.

Many times the qualifications which make the man fitted for the work are almost impossible to determine or analyze; at least, their discovery requires much searching study and sympathetic guidance. The present method of choosing a vocation in an offhand manner in high school and then entering college directly, or, what is even worse, of entering the technical school direct from high school and choosing a course of naval architecture during the first or second year at haphazard from among other engineering courses offered, is absolutely wrong and will seldom meet the above requirements. Too often the parent and instructor do not have a clear idea, and the student a false idea, of naval architecture.

It is evident that this first requirement is very difficult to fulfill faithfully; yet it is one of basic importance. In fact, it is the great problem that every young man, largely ignorant of his own capacities and without inward guidance towards his vocation, is called upon to face. A discussion of this point is beyond the scope of this article. Might not the universities or the Society for the Promotion of Engineering Education reach out into the high schools and guide the student? Associations, environment and the vocation of the boy's father are bound to have important weight in molding the boy for a future in naval architecture.

Later I shall discuss a system of training in which the student spends a year at practical work before entering

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college. By following this scheme the student acquires a wonderful insight into the requirements and duties of the profession he proposes to follow, as well as a knowledge of his own temperament and bent. It is one of the best methods possible of solving this difficult yet basic problem.

The second requirement for a training in naval architecture is that the course should be so laid out that a man will obtain a well-rounded education and broad outlook to fit him for the duties of a naval architect, shipbuilder or ship operator. The training should cover the fundamentals of science and engineering, naval architecture, the design and construction of ships, the essentials of heat engineering and marine engines; a study of the management of the shipbuilding industry, and the operation and maintenance of ships.

These subjects should be considered not only from the technical standpoint, but also from the practical and economical standpoint and the point of view of the business man. Such topics as initial cost, overhead expenses, cost of operation of ships, size of ship and earning capacity, types of machinery to install in a given vessel for a given trade, time required in port for unloading, etc., are all problems that the naval architect should be able to handle. The naval architect of the future will find these questions of equal, if not more, importance than the more strictly technical problems of his profession.

Broad Outlook Upon Ship Operation Problems

The whole course of training should be measured, not by the knowledge gained, but the insight into the underlying principles and the ability to give the proper weight to the theoretical, practical and economic consideration of any problem. The man must not acquire technical skill alone, but the ability to control enterprises and to decide in particular cases whether the undertaking is actually worth while or not.

He should be able to grasp the whole problem, financial and economical, as well as technical. To design a ship that is technically correct in all details is one thing; to design an efficient ship when financial and economic conditions are taken into consideration is quite another proposition. Graduates in naval architecture in the past have too often felt it their duty solely to carry out the technical work in naval architecture. To fulfill the demands of the future, naval architects must be more than this; they must be leaders in the shipbuilding and shipping fields as well as technically trained men. They must create, not copy; originate, not accept.

In order that the student may master the essentials in the whole field of naval architecture, he must be in close touch with the practice and management of shipbuilding and ship operation from the very beginning of his training, as well as be pursuing the customary course of study in college. It must be borne in mind that the student is preparing himself to earn a living in a world of business, and the sooner he learns its demands the sooner he will meet with success in his profession.

Practical Work in the Industry

To attain this end, practical work in the industry, by co-operation between the school and the shipbuilding plants and steamship lines, should be a feature of the course of training. The existing college courses of naval architecture in this country do not demand this practical training, and in this respect I believe that they are weak. Practice is a complement to theory, and the two cannot be separated in a course of training.

A number of ways are open to obtain this practical part of the training. One scheme, which is followed almost universally in Great Britain, is to require several years of outside practice before entering the technical school. The apprentice system, in which nearly all the men eminent in naval architecture in Great Britain to-day obtained their training, is a most excellent plan, but could not be put into operation unless the shipyards co-operated to the fullest extent. The aptitude of the boy for the work would also have to be given the most careful consideration early in life. By this plan the boys are apprenticed to a shipyard, generally a government dockyard, at about fifteen. They attend a yard school several afternoons a week, where careful attention is given to their education. After from four to six years of apprenticeship, the best qualified boys enter the technical school for the usual four-years' course. The achievement of the men educated in this manner, among whom were such men as Sir William White and Sir Nathaniel Barnaby, certainly indicates that the system has considerable merit. As far as I know, the plan is not followed in engineering education in America.

The well-known Cincinnati plan of two weeks in the industry followed by two weeks in school is another solution. The English "sandwich system" of a year in school alternated by a year in practical work is of the same character. Both have been criticised because the classroom work is too often broken up and serious interruptions are introduced into the curriculum.

A third scheme is that of requiring practical work during the summer vacations. This system is already in use in some of the schools in this country. From my own studies, I believe that a combination of the first and last schemes, requiring one year of practical work before entering college, followed by three summers of work in the yard and at sea, would accomplish the best results. This would give the student an insight into the profession and a tangible interest in the school work at the very start. It would either spur him on to better work in college or show him before it is too late that his real interests do not lie in the field of naval architecture.

It is very essential that all this practical work be directed by the college faculty, and thorough co-operation, as in the Cincinnati plan, exist between the school and shipbuilding and shipping industries. Otherwise the time of the student will be more or less wasted and the desired results will not be accomplished.

With the proper directing and planning of the high school work, the high school course could be shortened so that the year of practical work need not necessarily lengthen the educational period. This, however, is not always possible or advisable, and in such cases an extra year would be required. The student who puts in an additional year in this manner, however, should be further advanced at graduation than the student who has not, and, in the final analysis, the period of training will probably be shortened.

It is extremely important that the boy be guided in this year between high school and college, otherwise the time will be practically wasted. Care should be taken to see that his habits of study are not broken up, by prescribing a course of study and reading. I concede that the accomplishment of this plan requires earnest consideration and is not as simple as the mere statement might indicate.

The requirements in practical work should include experience in shipyards and shops where methods of construction and handling material can be observed, and experience in the drawing and designing offices where plans and technical calculations are made and materials ordered. Some time, also, should be put in in the shipyard offices, where there is an atmosphere of business. Finally, a short time should be spent on shipboard, where the han-

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dling of ships and their machinery can be studied. This part of the training will also give the student an opportunity to observe the action of a ship at sea, which will cause him to take a more appreciative attitude towards the classroom work dealing with the stability and strength of ships. If possible, a few weeks' experience in a steamship office should be included in the training, so that the methods and practice of a steamship line can be observed.

If the above plan of practical training is followed, practically all the shop work can be dropped from the school curriculum. This will allow the time saved to be used for courses in literature, history and economics, which at present are not given enough attention.

The practical work in the course as outlined would require from a year and a half to two years of training outside of the classroom. I do not mean to assume that in this short time the student will become conversant in all the fields mentioned, or become skilled in any trade or branch of the profession. In fact, I fear he will have a rather superficial knowledge of the whole field, perhaps vague and obscure in some particular branch. Nevertheless he will have observed much that will incite his interest and study; he will have acquired a knowledge of materials, tools and processes; he will have seen the order and distribution of work and have learned to appreciate the money value of time and labor and material. He will also have obtained unconsciously an engineering instinct and a knowledge of proportions and dimensions of machinery and structure that will be invaluable to him in his college work. He will have mixed with different classes of men, discerned their points of view, and acquired a sympathetic understanding of them, which is of prime importance for one who may in the future be placed in charge of men. Most important of all, he will have seen the industrial world in operation and be imbued with its methods and spirit.

The College Curriculum

Having considered the practical side of the training, let us now turn our attention to the school curriculum. The professional studies should begin at the start of the freshman year and not be left, as is the present custom, until the third and fourth years. These early professional studies should be introductory courses in general engineering and naval architecture only, and the subjects should be treated in an elementary manner. The rigid mathematical treatment of the professional work should be left, as at present, until after the foundation work in mathematics, physics and mechanics has been covered. Short laboratory courses could be introduced in the freshman year with great benefit.

There are several reasons for starting the professional work early in the course, which are of paramount importance when the practical work is to follow the scheme I have just outlined. It is necessary that the professional work should parallel the outside practical training so that one will be an explanation and complement to the other: the student's enthusiasm and interest in his life's work should be aroused early and kept constantly at the highest pitch in order to accomplish the best results. These introductory courses will teach the student his limitations and create a greater incentive to master the more abstract sciences which are necessary for the study of theoretical naval architecture, ship design and construction. It is a fact that a student will assimilate very little in a subject that does not interest him; and any arrangement of the course that will create a lively interest and enthusiasm in mathematics, physics, thermodynamics, etc., will have a wonderful effect on the student's progress.

Courses in English should continue throughout the four years. The student's experiences and observation in his outside work will make excellent subjects for compositions and take away much of the antipathy that the student as a rule has for this subject.

Aside from these two considerations the present layout of the freshman year in most engineering schools fulfills the needs of the first year of a course in naval architecture. In arranging the course, the summer work to follow should be kept in mind, so that the outside time will be spent to the best advantage.

By the time the student reaches his third year he should be familiar with the principles of ship construction, the drawing and fairing of ship's lines, and the making of half models. He should also have covered the elements of naval architecture and general engineering and practically all of the work in physics, mathematics and chemistry.

The work in mathematics need only go through calculus. Any advanced work in mathematics should be left to the student's volition later in the course. A thorough mastery of the work in calculus and the ability to apply it in engineering work in later life is far more important than wading through more advanced work in differential equations with a rather vague knowledge of the whole course and little ability to apply it when the need arises. I do not wish to be understood as depreciating the more advanced work in mathematics. The student, by all means, should be encouraged to continue work in mathematics throughout the four years, if he has the proper aptitude. While this advanced work will be far in excess of that which can ordinarily be used in practice, it will fit him for any possible contingency that may arise in the future for original work.

The third year should start out with a technical study of ship design and the more advanced work in naval architecture. About the middle of the third year an actual problem in ship design should be started, which should continue until the end of the fourth year. This problem cannot be carried through exactly as it would be in practice, because many of the subjects will not be taken in class in time to be worked into the problem in their proper sequence.

Specific Problem Worked Out

The problem should consist, first, in selecting the proper dimensions, proportions and coefficients to meet an assigned condition. Then a preliminary estimate of weights, stability, trim, freeboard, deadweight and power should be made and a preliminary set of lines and arrangements plan be drawn up to see if the proposed boat meets the assigned requirements. Finally, a certain amount of the construction plans should be drawn and final calculations for weight, stability, displacement, power, strength, etc., carried out. It is extremely important that coefficients and data from good practice be available and the student taught to apply these to his design.

Let me amplify upon this problem in design, for it is one of the most important parts of the course. Here the student sees his professional studies applied to an actual design. The work on the problem is similar to that which he will be called upon to perform in the early part of his career. The theoretical work is illustrated, and the lectures made real and tangible by the application of their contents to the problem in hand.

The question of stability should be carefully covered in the problem by having the student design to a required minimum G. M. An actual calculation for the vertical center of gravity should be carried through. The required G. M. of the problem should be that for the ship

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loaded ready for sea. The G. M. in the light condition should also be calculated, and should at least show no negative value. Zero ought to be the minimum. If necessary, the loaded G. M. will have to be increased to meet this condition. The value of metacentric height on the ship's behavior at sea might be studied at this point, and the necessity of keeping it as low as compatible with safety brought out.

After the main features of the design are finished, various details may be assigned to various members of the class to be drawn up and calculated for strength. One or two members of the class will probably work up the special details by themselves. The work of the individual men can be brought to the attention of the whole class by having the students gather around the various boards from time to time and talk over the work with the instructors. The following list suggests a few details that can be assigned: Stem; stern post, rudder and rudder bearings; propeller struts or bossing and stern tube; superstructure and house construction; masts, booms and winches and hatches; anchors and anchor gear; and the layout for boats and davits. Various parts of the shell plating, decks, longitudinals, inner bottom and bulkheads can be drawn up and calculated for strength by each student.

The following subjects should receive careful attention during the third or fourth years, and the ship, already in the course of design, could be used to illustrate them: Tonnage, deadweight and freeboard requirements, floodable lengths, watertight subdivision and location of bulkheads as required by the Report of the British Bulkhead Committee, Lloyd's or similar construction rules, longitudinal and transverse strength and strength of miscellaneous details, riveting, bulkheads, etc. Consideration should also be given to the power and propeller calculations, the drawing of the stern lines, and propeller bossing.

The proportions of the boat, the number, location and revolution of the propellers and the proper angle of the bossing for the most economical performance of the boat in service should be studied and discussed. Taylor's "Speed and Power of Ships" is by far the best text for the study of power and propellers.

Development of Original Designs

Too much attention should not be given to following the rules of the registration societies. A few weeks' work will familiarize the student with their use, which is sufficient. The main work in structural design should be of a more advanced nature, following the method of study as in Professor Hovgaard's excellent book, "The Structural Design of Warships." The naval architect must be able to understand and analyze the stresses that come upon a ship, and place the material most advantageously to resist these stresses. No advance in naval architecture can be accomplished by merely teaching the student to follow existing rules of ship construction, despite the fact that these rules are based on years of experience.

The work in marine engineering should take up such subjects as the selection and arrangement of the propelling machinery and auxiliaries, the heating surface, and fuel consumption of the boilers for a given steam consumption of the engines. After these points have been incorporated in the problem, a consideration should be given to the economics of steam engineering. This should cover such subjects as fuel consumption for various types of propelling machinery, boiler economy, feed heaters, economizers, effect of leaky condensers, etc. All these problems are given careful attention in power plants on shore, but are too often overlooked on shipboard. A good naval architect should be well versed in steam engineering and should be taught to study the economical problems of the machinery, as well as those of hull design.

Other subjects covered in the third year should include advanced mechanics, steam engineering and laboratory work, electrical engineering, hydraulics, metallurgy, English and economics of engineering.

In the fourth year the design problem should be continued and the more advanced parts of theoretical naval architecture be taken up. Some attention should also be given to heating and ventilation and aeronautics. A portion of the year should be given over to marine engineering, including engine design, steam turbines, boilers and Diesel engines. The importance of studying these subjects from the economic point of view has already been mentioned.

We should not lose sight of the fact that the design of a ship embodies nearly all branches of engineering, and, in mapping out the design, the naval architect must have sufficient knowledge to give all the problems preliminary consideration and due weight.

By the fourth year the student should be able to choose for himself what division of the field of naval architecture he hopes to follow. Highly specialized options in ship design, shipbuilding and ship operation should be introduced in the last year. This should be the only place in the course, however, where specialization is allowed, for the young engineer can seldom foresee what trend his career is likely to take. Men successful in naval architecture often, in later life, do not follow the particular line along which they start. Of two men, one with the broad grasp of the underlying principles and the other with a highly specialized knowledge of one branch, the former is better able to take advantage of opportunities for advancement.

Special Subjects

In addition to the subjects mentioned, some time should be given to training in yacht design because of its value in teaching the form and "sweetness" of ship's lines. The essentials of this field should be covered in case a student elects it as his life's work. History of naval architecture should receive treatment, if only by assigned reading, so that the student can face the future with an acquaintance of the achievements of the past.

The course in economics, after covering the fundamentals of the subject, should take up concrete problems in connection with the work in naval architecture. Such a problem as steam versus Diesel engines for a given trade route and given vessel could be discussed with regard to first cost, ability to obtain a supply of fuel oil, cost of operation, depreciation, repairs, etc. Or, again, a problem on the size of a ship for a certain trade could be taken up, and such points as interest on investment, time required in port for loading and unloading and opportunity to obtain a cargo be considered.

Such a course would require co-operation between the instructors in economics and naval architecture and talks by men actually engaged in shipping. The department of naval architecture could also introduce, at this time, the economic consideration of the design problem already under way.

Special attention should be given to laboratory work, as the student can acquire a great variety of knowledge and experience in the laboratory that he could only obtain after years of practical work in the industry. The students should carry on the work in the laboratory in small groups and be allowed to do everything themselves as far as possible. If it is an engine test, for instance, the students should start and care for the engine while running,

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attaching the indicators and the other apparatus necessary. In short, the students should be given complete control and left to their own resources to work out the problem. The instructors and mechanics should interfere only when absolutely necessary. While I was on the faculty of the University of Maine, this used to be our practice, and the enthusiasm aroused and the results accomplished were very encouraging. We carried out a three-day plant test in this way, giving the students complete control even to the firing of the boilers. A recording steam gage, kept in the laboratory, gave a record of each student's firing and created much interest and competition among the men. I believe that more of actual boiler performance and methods of firing was learned by the student in his two lessons of firing than weeks of instruction could have accomplished.

CONCLUSIONS

The foregoing briefly outlines the field that should be covered for a training in naval architecture. Before concluding, I wish to add a few remarks regarding the method of presenting the work. The tendency in many of our engineering schools is to try to cover too much ground. As a result, the student graduates with a rather confused conception of the various subjects instead of a strong framework of the principles of engineering. The work, I believe, should be so taught that the main points are forcibly brought home and inculcated upon the student's mind, and the less essentials treated in a more cursory manner for the student to master at his own convenience as future occasions may demand.

First, he should receive a strong foundation in basic principles and theory and a strong framework in the professional studies, with as much amplification as time will allow. Then he should receive careful instruction to show him how to build upon this foundation and how to go about filling in the framework, by study and reading after graduation. It should be borne in mind that the student's training is not completed; in fact, it has just begun at graduation. It is true that the theoretical work is largely finished at this time, but there are years of practical work and experience ahead that must be tempered and rounded out by further study. This fact is too often entirely lost sight of by the young engineer and naval architect. It is the duty of the college faculty to point the way for his future development. Here professors who have had wide practical experience can draw on their own experience in pointing out the proper path for the graduate to follow.

Great care should be taken to see that the courses are properly interrelated, so that the student sees the connection and transition from one subject to another and is able to apply the basic sciences to his professional studies. An excellent way to do this is for the department of naval architecture to take the men after they have finished a course in mathematics, mechanics, etc., and put them through a short intensive review of the more important parts and illustrate this review with problems in naval architecture, ship construction, etc. For example, the course in mechanics could be reviewed in this manner by showing the application of the more important parts to ship design. Problems in strength of bulkhead stiffeners longitudinal shear in a ship's structure and the like should be assigned. This method brings about a clearer understanding of the subject by presenting it from an entirely new viewpoint.

The above proposal for obtaining interrelation of the courses is only given as a possible solution, and would probably need some modification before it could be put into practice.

Before graduation, problems should be assigned that will cover the work of several subjects in one problem. These problems will not only test the student's knowledge of the whole course of training, but also his common sense, judgment and ability to tackle original problems. Just to give one example: a problem on the electrical steering gear for a ship could be assigned. This would require a knowledge of rudders and the steering and maneuvering of ships, the friction of mechanism, the calculation of the power for the steering motor, an investigation of the torque and efficiency for electric motors, and, finally, the selection of the proper type of motor for the work. Many other problems of this nature in marine engineering, naval architecture and ship design will readily suggest themselves.

These suggestions for a course in naval architecture will tend to produce a course that is more practical and purely professional than the general run of engineering courses offered at present. For this reason it is very important that purely educational and humanistic subjects, such as history, English literature and economics, be included in the training.

The instructors in these subjects should be men of high ideals and broad education, so that the student will have the other side of his personality developed by association with men of such character. For the same reason, athletics and other student activities should be encouraged. We must not lose sight of the fact that one of the principal functions of a college is to make a man out of the boy—to teach him straight thinking and clean living. "In the making of a man all the rich forces of nature and civilization must have place." The trained architect should be a leader in the world, a man able to meet and understand the problems of the day as well as carry on the purely technical work of his profession.

The course of training as outlined is rigid and exacting. It will require the student's best attention and ability for five years. The vacations will be short, but the study and classroom work will be pleasantly interrupted by practical work in the yard shop and at sea.

With a course of training as suggested, the student will enter college with a clearer knowledge of his own qualifications and the scope of his profession; he will pursue his studies with a more appreciative attitude, and will recognize far better the application of theory to practice; he will leave school with a strong framework of the theoretical, economical and practical branches of naval architecture, with a clearer vision of his future, a more definite purpose, and a more intimate personal knowledge of what is required of him in the industrial world than the graduates of the past.

VICKERS' SUBMARINES.—In a period of fifty-one months of war, Messrs. Vickers, Ltd., built and commissioned fifty-four submarines of all classes for the British Admiralty. An interesting description of these vessels is given in a recent issue of *Engineering* (London), from which the following data are taken:

Type	Number	Length	Submerged Displacement, Tons	Horsepower
"E" class	15	181′	780	1,600
"V" class	4	147′ 6″	460	900
"G" class	6	187′	840	1,600
"K" class	6	339′	2,570	10,500
"N" class	1	.....	.....	.....
"H" class	10	171′ 9″	510	960
"L" class	9	238′ 6″	1,090	2,600
Other types	3	.....	.....	.....

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UNITED STATES BATTLESHIP IDAHO

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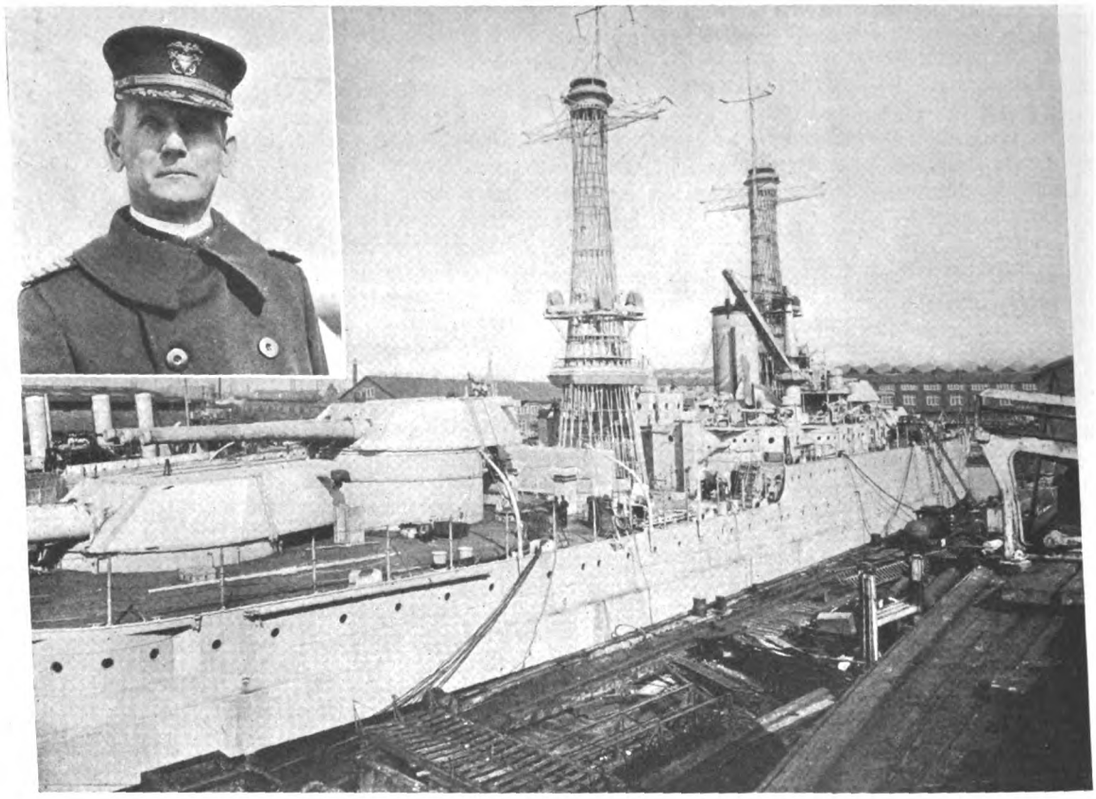
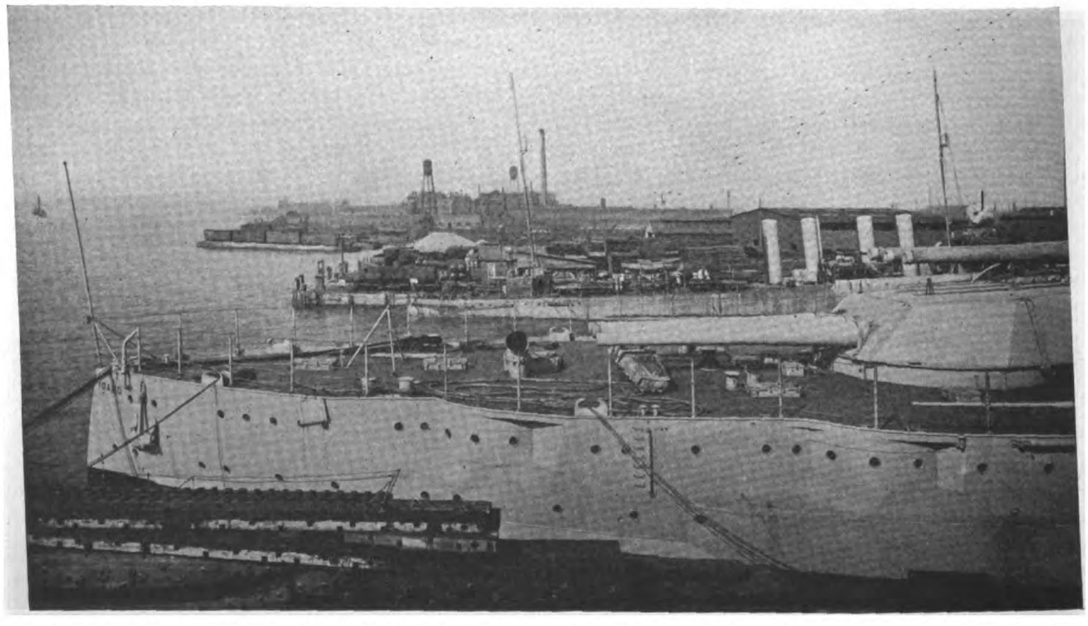


The *Idaho* and Her Commander, Captain C. T. Vogelgensang. The Stern of the Vessel Is Shown Below



The *Idaho*, Built by the New York Shipbuilding Corporation, Camden, N. J., Was Commissioned in March. Length, 634 Feet 6 Inches; Beam, 97 Feet; Mean Draft, 30 Feet; Displacement, 34,000 Tons; Horsepower (Parsons Turbines), 32,000; Armament, Twelve 14-Inch and Fourteen 5-Inch Guns

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UNITED STATES BATTLESHIP IDAHO

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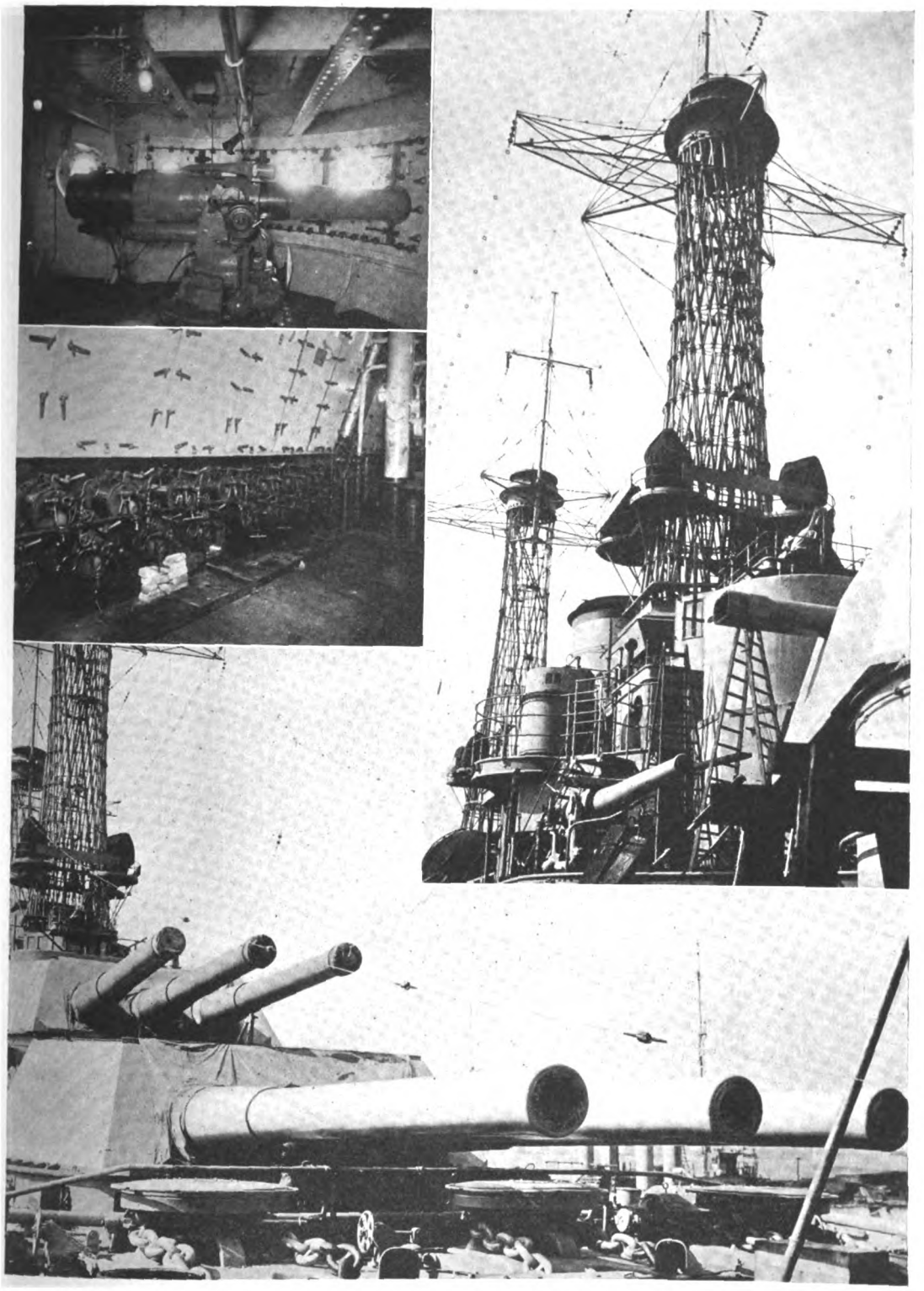

Views on the *Idaho*, Showing After Turrets and New Wireless Aerials, One of the Guns of the Secondary Battery and One of the Firerooms

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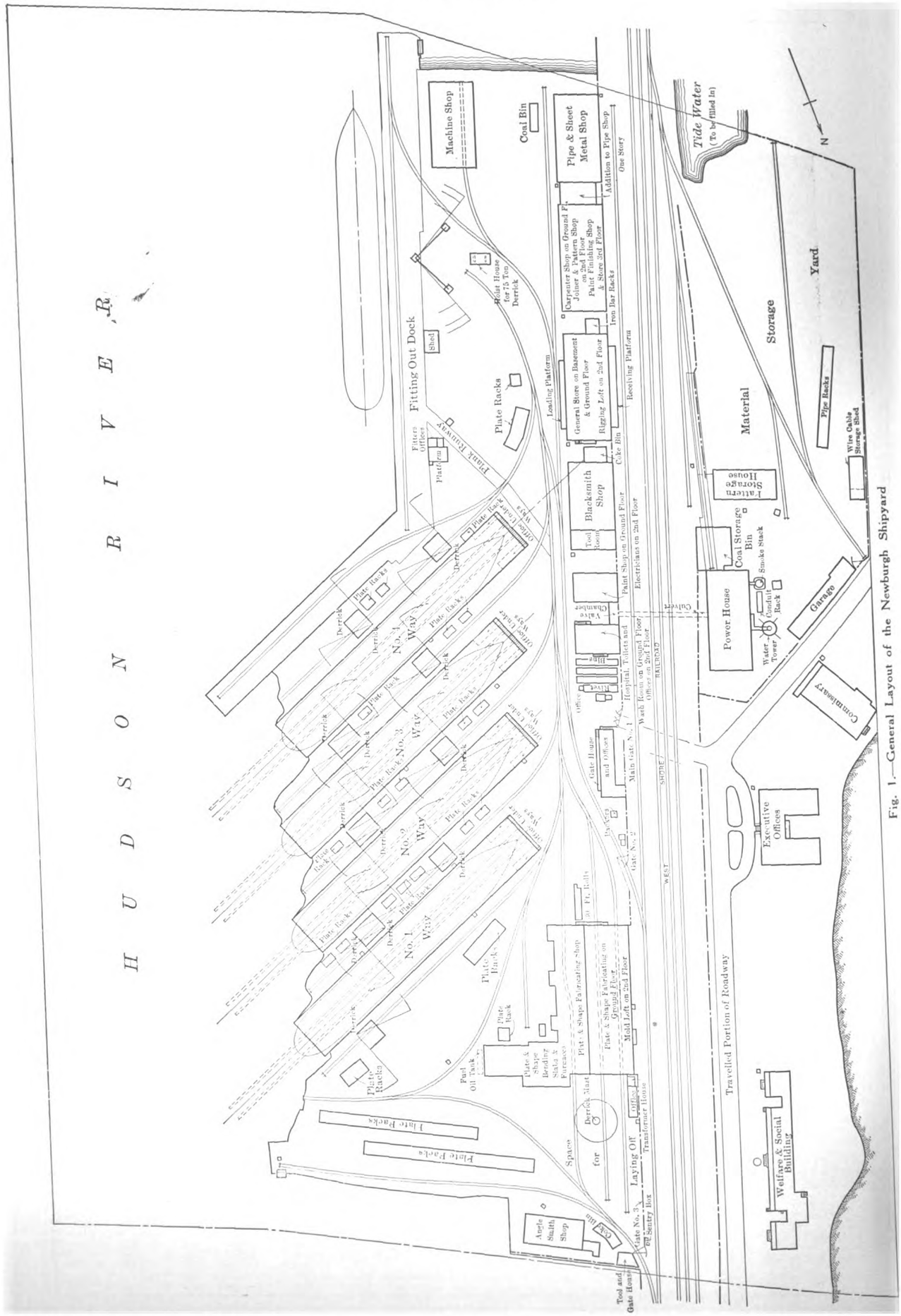

Fig. 1.—General Layout of the Newburgh Shipyard

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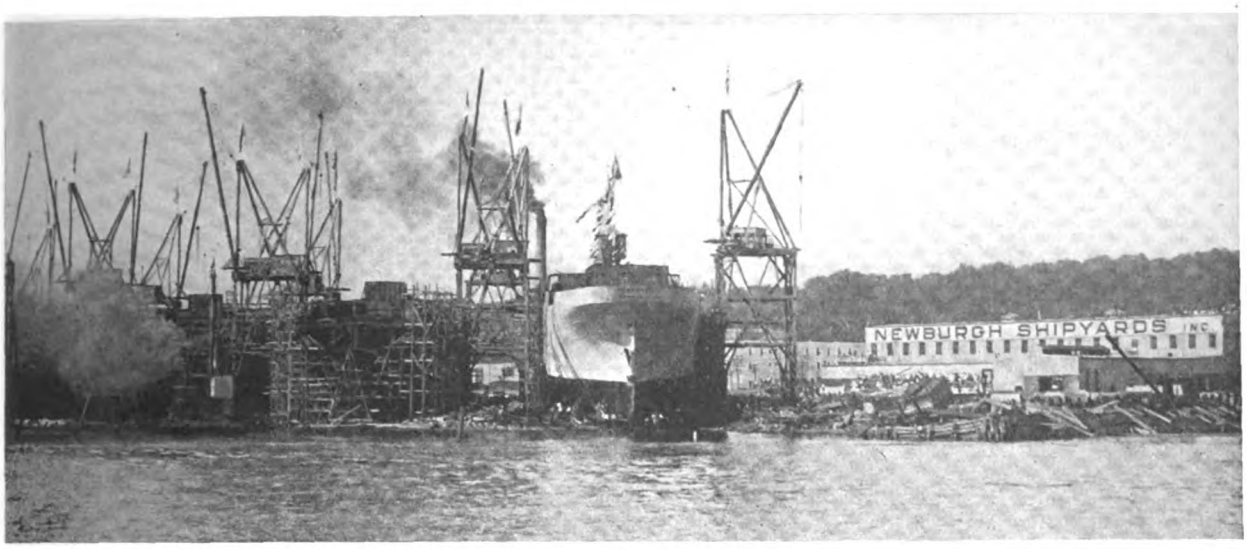

Fig. 2.—View of Newburgh Shipyard from the Hudson River

Construction of the Newburgh Shipyard

Efficient Plant on the Hudson River Built in Record Time for War Work—A Story of Successful Accomplishment

A CAREFUL review of the accomplishments of American shipyards during the last two years of intensive shipbuilding shows to how great an extent success has been dependent upon suitable location, accessibility and environment—and this particularly is true with the shipyards born of the war emergency. It is, therefore, fitting that we present to our readers a description of the Newburgh Shipyards, Inc., whose record during the past year has been one of successful accomplishment.

Located about fifty-nine miles from the heart of New York city on the west bank of the Hudson River and one mile from the historical old city of Newburgh, this shipyard is served by the New York Central, West Shore, and Erie railroads, as well as several steamboat lines, both passenger and freight, operating between New York and Albany in addition to the New York State Barge Canal, connecting with Buffalo, so that ample and adequate transportation for men and materials is assured. The Hudson River at the shipyard is about one mile and a quarter in width and forty-four feet in depth, so that vessels of large tonnage and deep draft may be launched with ease.

Building Berths Limited to Four

The arrangement of shipyard, building berths and buildings was planned and laid out under the personal direction of Edwin C. Bennett, vice-president and general manager of the company. After a careful study of the most efficient shipyards in this country and Europe it was decided to limit the number of building berths to four, as experience has proved that under normal conditions, and particularly during periods of keen competition, the most successfully operated shipyards are those having an average of four building berths.

The yard as at present constituted has a waterfront of slightly over one-third of a mile in length and covers an area of twenty-four and one-half acres. The layout of the yard, as will be seen from Fig. 1, is so arranged that raw steel material is delivered at the north end and passes

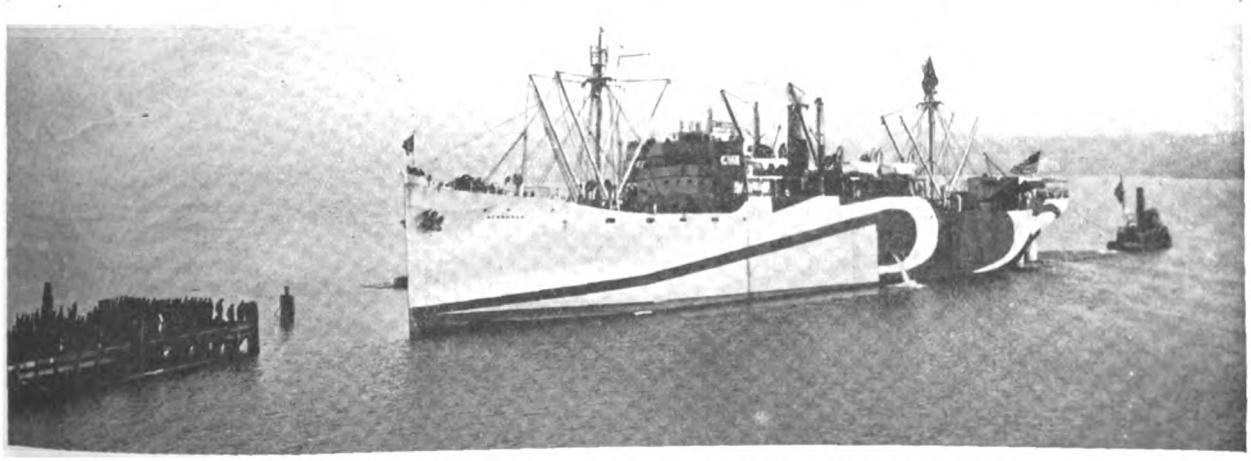

Fig. 3.—S. S. *Newburgh*, First Vessel Built at the Newburgh Yard, Leaving for Her Trials

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Fig. 4.—Panoramic View of Newburgh Shpiyard

from one operation to another without at any time retracing its path, and the finished ship is delivered at the south end. Material, other than raw steel, enters the yard on a different line of rails, so as to avoid passing through that portion of the yard devoted to fabrication of steel. Material destined for the general stores is unloaded direct from the railway into the main storehouse without having to enter the shipyard proper.

Arrangement of Shipways

The four building berths as at present operated are each capable of taking a vessel up to 475 feet length between perpendiculars by 70-foot beam, but arrangements have been made for lengthening if occasion requires. They are spaced 100 feet on centers, so as to permit placing a standard gage railway track and storage racks for fabricated steel for material alongside each berth. The ready service storage racks alongside the building berths have been found of great advantage, as they permit the proper location of material as and when required, so as to enable the overhead cranes to operate at high efficiency.

The four building berths are served by twelve stiff-leg derricks mounted on towers, these derricks being so arranged that one ship, if so desired, may be served by five booms at one time. The booms are eighty feet in length and have a lifting capacity of five tons at extreme radius.

Fitting-Out Docks

There are two fitting-out docks of a combined length of 1,010 feet, with railroad tracks thereon, so as to permit the economical handling of material direct to the ships afloat. The fitting-out crane is also of the stiff-leg derrick type, designed for a test load of ninety tons and a working capacity of seventy-five tons at eighty feet radius and a ten-ton capacity at one hundred and ten feet radius.

The work of building the shipyard commenced in July, 1917, and, whereas most shipyards made land by dredging the river front, the great depth of water and the heavy clay soil at the Newburgh yard prohibited this procedure. It was necessary, therefore, to excavate by steam shovel a hill on the west side of the main line of the West Shore Railroad and deposit it in the river on the east side of the railroad. Work proceeded apace, and, as will be seen from the photographs, sufficient land was made by September, 1917, to permit the start of building construction.

Layout of the Yard

The size and disposition of the various buildings are shown on the plan of the yard. The buildings are all of brick and concrete construction and comply with the rigid

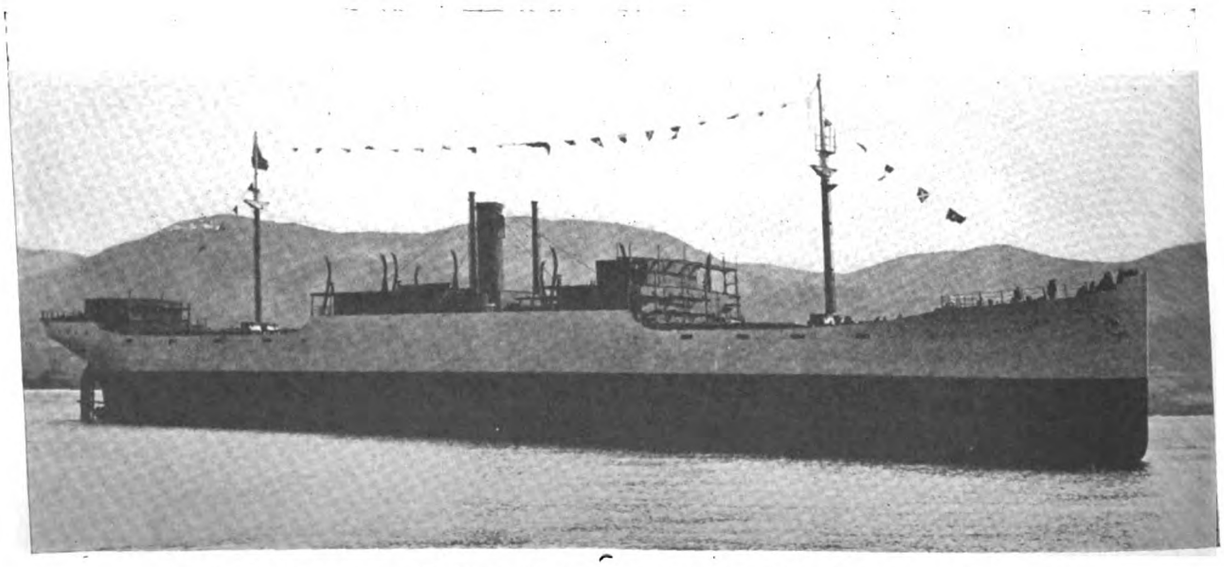

Fig. 5.—9,000-Ton Steamer *Walden* as She Appeared on the Day of Her Launching, February 1, 1919

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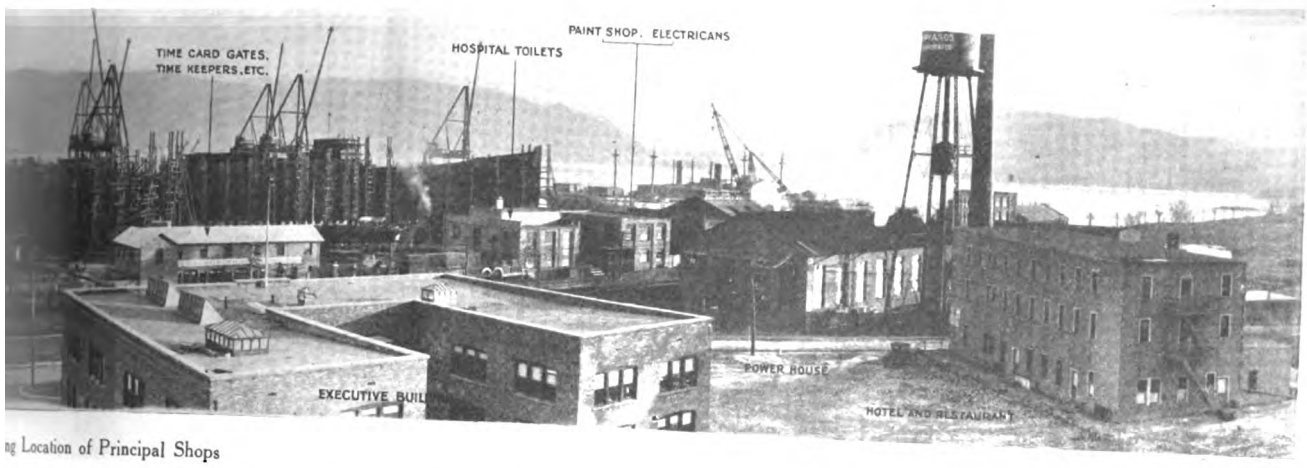

ng Location of Principal Shops

factory laws of the State of New York. Washrooms and toilets for the workmen are installed on every floor in each building—in fact, throughout the plant the comfort and welfare of the workmen in the yard have received every consideration.

It will be noted that a very extensive arrangement of standard gage railway tracks permits the rapid and economical handling of material to all parts of the shipyard, and in keeping therewith seven locomotive cranes and a gasoline (petrol) shunting locomotive have been installed in addition to the stiff-leg derricks over the ships.

Progress of Ship Construction

The Newburgh shipyard has under construction ten steel cargo vessels each of 9,000 tons deadweight capacity. The keel for the first vessel, which was named the S. S. *Newburgh*, was laid on March 14, 1918, and delivered to the Shipping Board on December 30, 1918. The fourth vessel, named the S. S. *Walden*, after a small town in the Hudson River Valley, was launched on February 1, upon the occasion of which the Newburgh Shipyards, Inc., was commended by the Emergency Fleet Corporation for being the first new shipyard on the Atlantic coast building steel vessels to launch from the full quota of its ways.

With the publication of this article, six 9,000-ton vessels will have been launched and three vessels delivered, all within one year from the laying of the keel of the first vessel. The present building programme calls for the delivery of one vessel every six weeks. This enviable record is due partly to the excellent railroad and freight facilities, partly to the staff of highly skilled foremen and executives, all of whom have had many years of shipbuilding experience, and to a great extent to the efficient system of training unskilled workmen put into effect at the shipyard and the cordial relationship between the workmen and the management.

Training School Established

The management, anticipating the shortage of experienced shipyard labor, installed even prior to the laying of the first keel a thoroughly competent corps of skilled shipbuilders in its training center. All "green" men entering the employment of the shipyard passed through this training school, with the consequence that there has been built up a force of properly trained workmen, nearly all of whom are permanent residents of Newburgh and the surrounding villages. The yard is thus a local enterprise.

In order to consolidate the labor, the United States Shipping Board Emergency Fleet Corporation has recently constructed houses for the accommodation of two hundred families. Owing to the natural beauty of the ground on which these houses are built and its adjacency to one of the public parks of Newburgh, the design and arrangement of the houses are of an unusually pleasing style.

Details of Vessels Built

The vessels now under construction at the Newburgh yard are of the two-deck, three-island type, with two pole masts and one stack. Each mast carries four cargo booms of five tons' capacity, with a thirty-ton boom for handling heavy loads. There is a large hatch to each hold; those to holds 1, 2, 4 and 5 are 29 feet 3 inches by 20 feet, and that to hold 3 is 18 feet by 20 feet. The crew is berthed in the poop, while the bridge deck enclosure is given over to cargo and the forecastle to storerooms, carpenter shop, lamp rooms, etc. The officers are housed in two houses on the bridge deck, the navigating officers occupying the forward and the engineering officers the after house. These vessels are of the following dimensions:

Length overall	417 feet 10 inches
Length between perpendiculars	401 feet
Breadth molded	54 feet
Depth molded	32 feet 10 inches
Designed draft	25 feet 6 inches
Deadweight carrying capacity	9,000 tons
Capacity for grain cargo	476,205 cubic feet
Capacity for fuel oil	1,260 tons
Capacity for bunker coal	1,846 tons
Capacity for feed water	137 tons
Capacity for drinking water	26 tons
Gross tonnage	6,099 tons
Net tonnage	3,783 tons

The vessel is driven by a 17-foot propeller operated by a Westinghouse turbine reduction gear. The turbine is designed for 3,600 revolutions geared down to 90 revolutions of the propeller shaft, giving an output of 2,800 shaft horsepower. Steam is furnished by three Babcock & Wilcox boilers of 200 pounds per square inch steam pressure and a total heating surface of 8,700 square feet.

Trial Data

The S. S. *Newburgh* and the S. S. *New Windsor* were transferred to the Naval Overseas Transportation Service for operation, and extracts from the deep-load sea trial of the *Newburgh* will illustrate the rigid trials that these vessels went through before acceptance. This trial constituted both an endurance and a speed trial, as the vessel

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Fig. 6.—Newburgh Shipyard as It Appeared on September 20, 1917. Taken from South End of Mold Loft

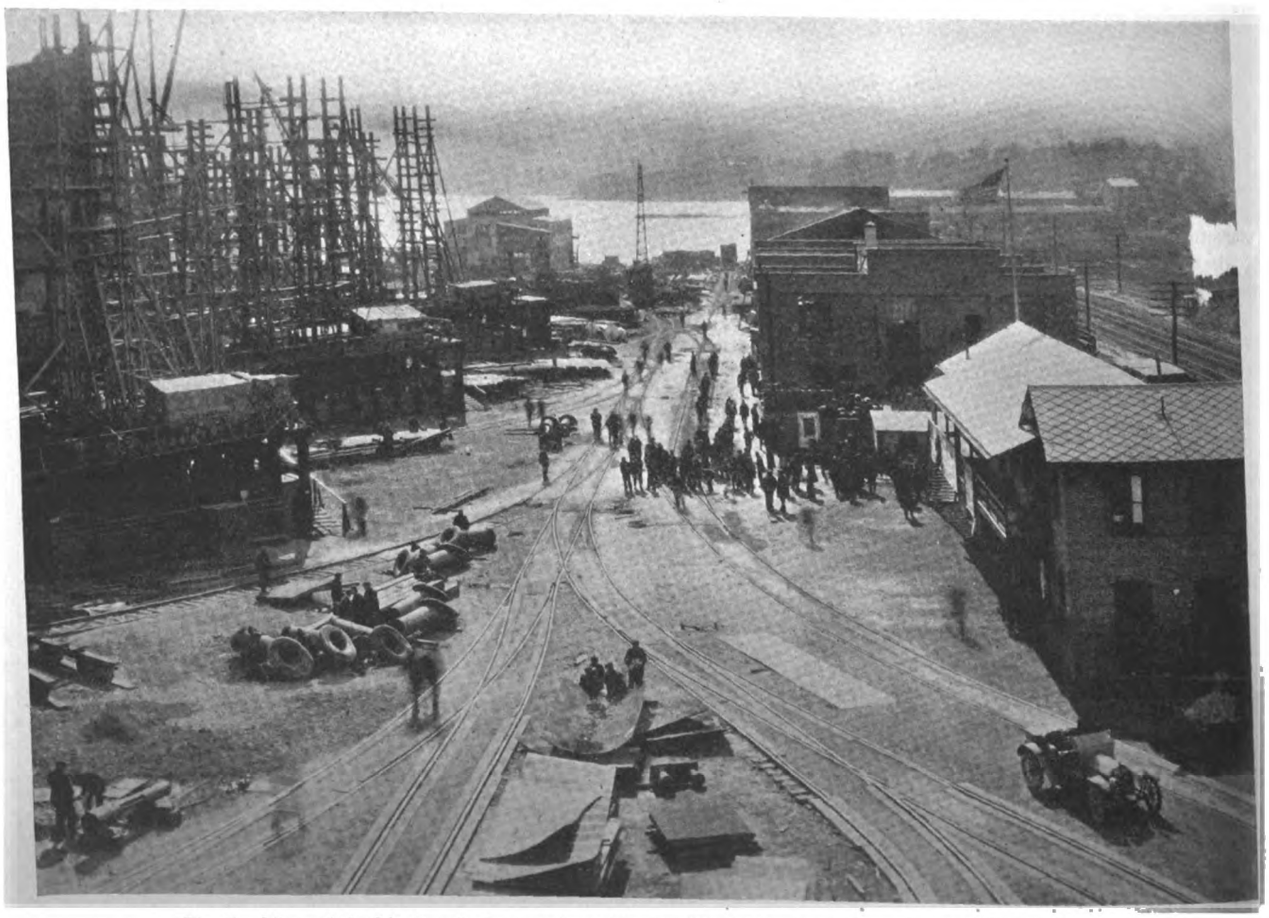

Fig. 7.—View of the Yard as It Appeared on February 17, 1919. Taken from South End of Mold Loft

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was run with the engines running at maximum capacity for twelve hours, of which three hours formed the speed trial, from which the following data have been taken:

Trial Data

Duration of full speed trial, hours	3
Average revolutions per minute	94.94
Estimated shaft horsepower	35.50
Vacuum, inches	27.4
Fuel oil, pounds per hour per shaft horsepower	1.34
Estimated speed, knots	12.4

Notwithstanding the fact that the above sea trial was very much in excess of the contract requirements, the vessel passed through these trials satisfactorily and shortly afterwards proceeded on her first trip to Europe.

New Baltimore Shipyard

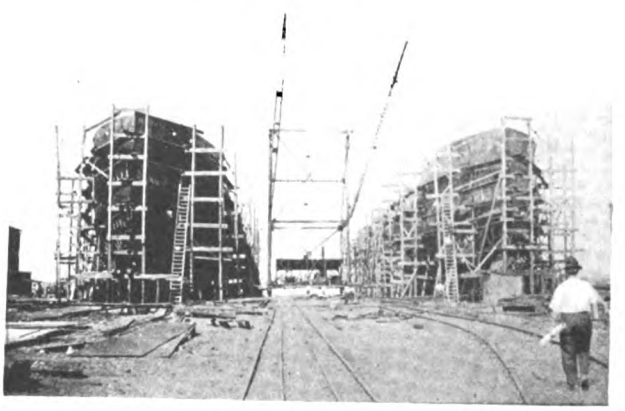
BY FRANK G. REINHARDT, JR.

IN the Union Shipbuilding Company on the Patapsco River, at Fairfield, Anne Arundel County, Baltimore is gaining an important addition to its already large shipbuilding industry. Besides the many independent shipbuilding projects which sprang into existence to meet the great war demand for tonnage, some of the largest steel-producing interests of this country, including the United States Steel Company and the Bethlehem Steel Company, have established plants to build steel steamships as an added form of consumption for their primary product. In a somewhat similar manner the Union Shipbuilding Company is an offspring of the large steel interests of the McClintic-Marshall Company, of New York and Pittsburgh.

When the McClintic-Marshall interests took over the plant of the Ellicott Machine Corporation on the old quarantine grounds on the Patapsco River only two small timber ways, upon which dredges for the Panama Canal had been built by the Ellicott concern, were standing, besides an inadequate punch shop, a small mold loft and an office building. In order to lose no time, and to take advantage of present facilities, these two ways were immediately strengthened by the Union Shipbuilding Company and two steel oil tankers, the *Monongahela* and the *Ohio*, were laid down for the Gulf Refining Company, Port Arthur, Tex., and later successfully launched.

In the meantime, work was rushed to construct two more timber ways, the contract for which was awarded to the Sanford-Brooks Company. Pile drivers with their active crews were soon upon the scene and worked steadily day and night. These two ways measured 400 feet in length and were completed in fast time. The keels for two large cargo steel barges for the Aluminum Ore Company of America were immediately laid on the new ways. Work on these two ships is rapidly nearing completion, and the hulls will no doubt be sent overboard shortly. These vessels are 315 feet in length, with a beam of 48 feet 6 inches.

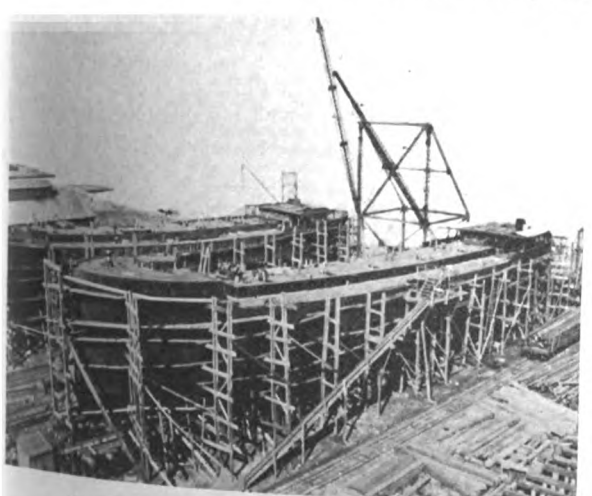
Erection of New Plate and Angle Shop



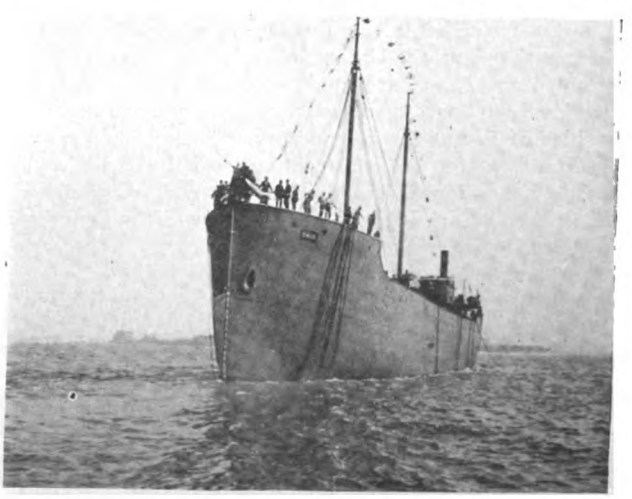
Monongahela and *Ohio* During Construction

Plate Fabricating Shop

The erection of a large modern plate shop was also completed, and this is now rapidly turning out fabricated steel for the ships on the ways. During the war the



Ship Under Construction on Ways Nos. 1 and 2



S. S. *Ohio* Just After Launching

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Union Shipbuilding Company turned out thousands of tons of fabricated steel, which was used at the mammoth Hog Island plant. The plate shop is built on the daylight plan and is equipped with the latest types of punches, shears and reaming machines, steam hammers, planers, radial drills, cold presses and riveting machines. The plates are quickly handled by a score of Shepard electric hoists operating on trolleys overhead. Plate and angle furnaces were also erected and quickly put into operation.

Reinforced Concrete Shipways

After the launching of the *Monongahela* and the *Ohio*, ways Nos 1 and 2 were torn down and two modern reinforced concrete ways are at present under construction to replace the old timber ways. One of these ways is completed and is ready to receive its keel, while the other is rapidly nearing completion. These ways are 400 feet in length by 65 feet wide and will be covered, thus enabling work to proceed throughout the year in all kinds of weather.

Two more ways of like dimensions will be built to replace the timber ways Nos. 3 and 4, and it is planned to add other ways of larger dimensions. Outfitting piers 500 feet in length are now being built, while it is proposed to construct a large reinforced concrete dry dock.

Cranes

Large cranes of the traveling type, supplied by the Heyl-Patterson Company, of Wilmington, will be installed at the head of the ways to facilitate and expedite the delivery of materials to all ships under construction. These cranes are of the portable tower crane type, having a third rail to supply them with the electric current needed for their operation. Heavy reinforced concrete runways with pile-driven foundations are now under construction for these cranes.

A large floating crane will also be put into service to speed up the work of fitting out the ships at the piers.

A new office building was recently completed, and the various departments of the company have taken possession. This building is of fireproof tile construction with a stuccoed finish. It has two floors and an attic and measures 250 feet long by 50 feet wide. A large warehouse of the same construction is also being built.

The present shop facilities will be greatly enlarged to meet the increased production, and a large gantry crane will operate across the entire width of the yard. A larger and spacious mold loft is also planned, and, as the need arises, new office buildings will also no doubt be erected.

Construction Camps and Commissary

In order to make it more convenient for the shipworkers at the plant, the Union Shipbuilding Company has constructed camps and a commissary. At a nominal fee, the workers can board at these camps and can secure any necessities of life at the commissary.

The contracts for the construction work have all been awarded to the Hughes-Foulkrod Company, Philadelphia, while all the pile-driving and waterfront work is done by the Empire Engineering Company.

As planned and equipped, the Union Shipbuilding Company will become one of the large units of ship production of this country. When completed, the plant will contain facilities for the construction of fourteen vessels at one time. The shipyards in Baltimore launched during 1918 nearly 180,000 tons of steel ships, and with this new productive capacity added to that which already exists, and with a continuance of the great demand for steel merchant bottoms, the Union Shipbuilding Company should add at least another 80,000 tons yearly.

As in the case of the United States Steel Company and the Bethlehem Steel Company, the Union Shipbuilding Company will receive much of its material for ship construction from the other plants controlled by the McClintic-Marshall interests, which are located at Leetsdale, Rankin and Pittsburgh. By this process of fabrication, the time required to build a steamship is materially reduced.

The plant of the Union Shipbuilding Company is reached by the Baltimore & Ohio Railroad, while the United Railways & Electric Company, of Baltimore, has extended its tracks to Fairfield. This enables the shipworkers to be in close and convenient touch with their homes in Baltimore. From 3,000 to 5,000 men will be employed at the new yard.

Government Building Large Number of Small Marine Gas Engines at Norfolk Navy Yard

AT the Norfolk Navy Yard the Government is operating the most extensive marine gas engine plant in the United States. Since August, 1917, the yard has received orders to build 2,296 engines of what is known as the navy type.

These are two-cycle engines and are used in small boats. They are one-, two-, three- and four-cylinder, or 5-, 10-, 15- and 20-horsepower, and were designed by the Bureau of Steam Engineering and the machinery drafting division of the Norfolk Navy Yard. The yard has been building these engines since 1913, and at the present time there are about 2,000 of them in use. The number of engines built since August, 1917, represents 23,355 horsepower, and of this number 1,384 built in 1918 represent 14,075 horsepower. The banner month for engine production was September, 1918, when 201 were built.

The progressive method in use in the automobile factories is followed in the main gas engine shop, and the parts follow a straight line down the shop, emerging a finished engine ready for the testing shop. They are given a 12-hour running test to develop any defect and are then stored subject to order.

Many of the engine parts are made at the navy yard, and only a few are bought commercially. When the parts start on their way through the shop they are first machined, then assembled, inspected and stored. Then they go to a progressive assembly track about 100 feet long and having ten stations. At each one of these stations the engine receives one or more of its parts and quickly develops into a finished product. When the engines leave the assembly track they are shunted onto a transfer and carried to the testing shop.

It has been stated that there is no private plant in the country which is able to compete in volume of output with the Norfolk Navy Yard in producing this type of engine. A force of about 200 workmen is employed at present.

Brown-Curtis Double-Reduction Geared Turbine Installation.—In a recent installation of Brown-Curtis double-reduction geared turbines made by the Wallsend Slipway and Engineering Company, Ltd., on a single-screw cargo steamer of about 9,100 tons deadweight capacity built by Messrs. Sir W. G. Armstrong, Whitworth and Company, the propelling machinery consists of three turbines working in series. The high- and intermediate-pressure turbines run in tandem, operating one pinion, while the low-pressure turbine operates a separate pinion, the power transmitted through the pinions being practically equalized.

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Foundation Company's New Orleans Yard

Located on New Ship Canal Connecting Lake Pontchartrain with the Mississippi River—"Unsinkable" Ships Under Construction

WHEN The Foundation Company (New York) drove the first piles for its New Orleans shipyard last spring, the nearest navigable water was five miles away. Since then dredges working on the new industrial canal for the city of New Orleans have cut a channel to the from the river to the lake. A lock is being built near the river bank, so that the water in the canal will always be maintained at the level of Lake Pontchartrain. The ordinary variation in the lake is only 2 or 3 feet, due to the small tide in the Gulf of Mexico. After heavy storms,

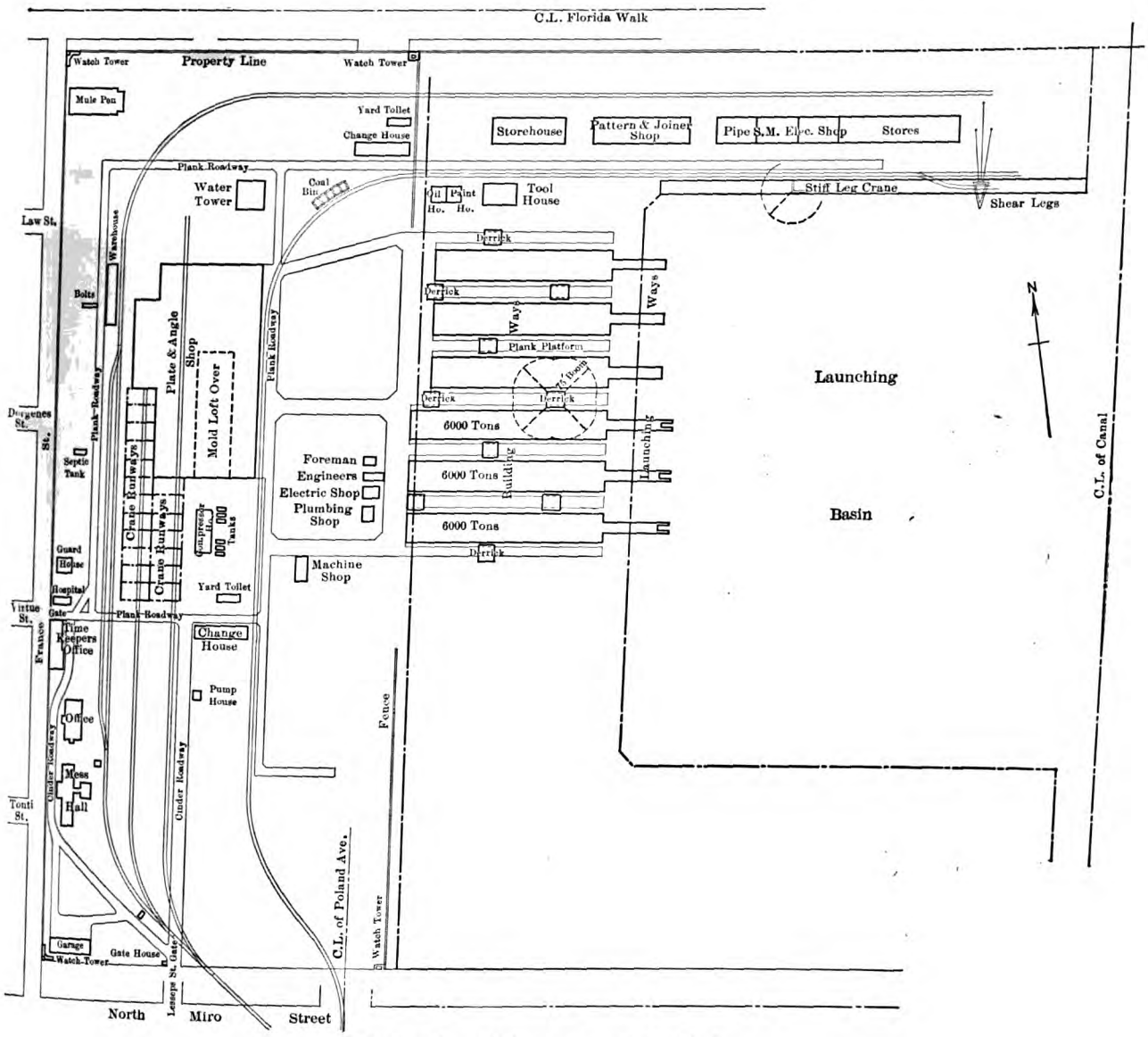

Fig. 1.—General Arrangement of the Yard

shipyard site, and before the first vessel is ready to start on her trial trip the canal will be open to deep water.

The location of a yard at New Orleans involved conditions differing widely from those in other parts of the country. The Mississippi River has a range of over 20 feet in elevation, making it unsafe to cut through the levee for launching ways. Lake Pontchartrain, on the other hand, has a depth of only about 9 feet, which is, of course, insufficient for large-sized vessels.

To overcome these disadvantages, the city of New Orleans has undertaken the construction of a ship canal there may be a variation of as much as 8 feet, but this is exceptional.

The canal will provide an inland waterway accessible to ocean vessels, which can proceed directly to the manufacturing plants established along its margins. An excellent shipyard site is also provided beside the wide turning basin at about the mid-length of the canal.

The property developed by The Foundation Company is on the west bank of the basin, adjoining a built-up section of New Orleans. As electric cars provide quick access to the center of the city at a minimum fare, no hous-

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ing problem for labor is involved. The yard is served by the Belt Line railroad and supplied with water and electricity from the city systems.

The size of the turning basin will permit end launching of the hulls, which has advantages over side launching in economy of waterfront and ease in handling material. There is ample space also for laying up vessels to be fitted out.

Layout of the Yard

Raw steel is brought into the yard on a standard gage railroad track and is distributed in the storage yard so that plates are near one end of the plate and angle shop, and angles and shapes near the opposite end. Steel is unloaded from the cars and stored by locomotive cranes. These cranes also load the material on small cars and push them into the ends of the plate and angle shop, where the material is handled by an overhead traveling crane.

Plate and Angle Shop

As shown by Fig. 1, the plate and angle shop is located in the center of the yard, just far enough from the head of the building ways to leave ample space for the storage of fabricated material before erection in the hulls. The roof is of saw-teeth construction, with provision for ample lighting of the interior.

A craneway runs along the entire length of the west side of the shop and extends beyond it 315 feet over the steel storage yard. A five-ton electric crane handles raw stock coming into the building from either end, loads stock on working skids from cars, or places stock so that it can be picked up by one of the two-ton hand cranes, which extend over the nine smaller bays along the east side of the shop.

In the main bay of the shop, where raw material is received, are the layout skids for plates, angles and shapes. The plate and angle furnaces are in a lean-to at one side. Each cross bay is laid out to handle a separate class of work and contains the tools necessary for the operations to be performed.

Method of Handling Fabricated Materials

The yard was originally laid out with railroad tracks running to the shipways. Locomotive cranes were to be provided, so that cars could be unloaded either at the storage piles or at the ways. This method was abandoned later on, however, and a tractor system submitted.

The yard is equipped with five small gasoline (petrol) tractors, which can travel from 3 to 20 miles an hour. A number of four-wheeled trailers are also provided. A system of plank roadways is built through the plate and angle shop and around the yard, so that tractors and trailers can carry materials to any point where they are needed. Light pieces are loaded and unloaded by hand; heavy pieces are loaded at the shop by the two-ton overhead cranes and are unloaded at the storage piles by small stiff-leg derricks conveniently located. When fabricated work is taken directly to the ways, the trailers are unloaded by the tower derricks.

Fitting-Out Wharves

Wharves are constructed along the side of the launching basin for use in fitting out the hulls. A 10-ton derrick is set up on one of these wharves and a 65-ton shear leg on the other wharf. This "shear leg" has a lifting capacity of sixty-five tons, sufficient to permit handling a Scotch boiler from a flat car to the hull.

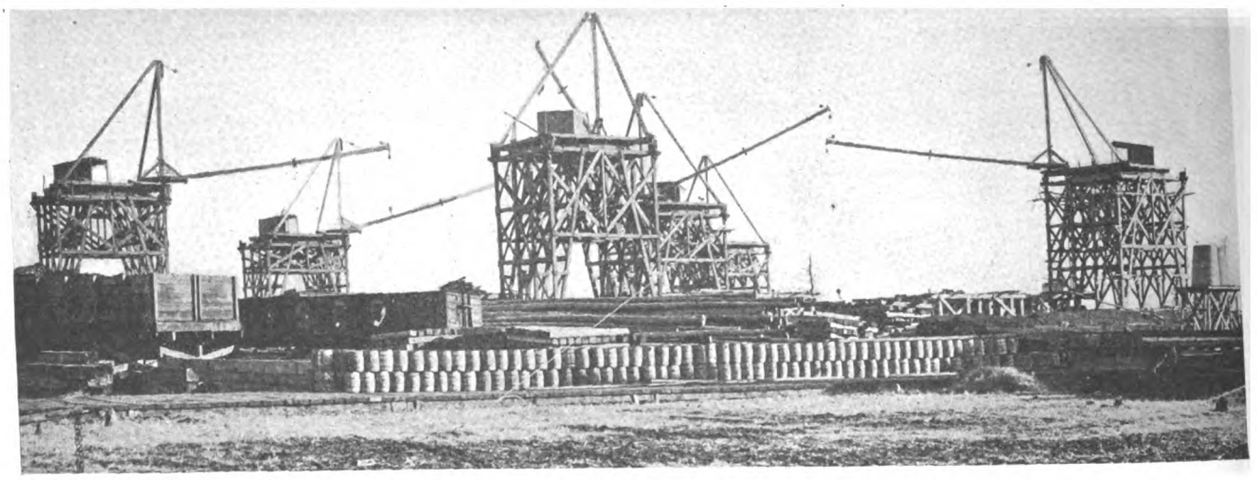

Fig. 2.—Tower Derricks at the Shipways

The buildings used in fitting out the vessels, such as the joiner shop, sheet metal shop, electrical shop, pipe shop and storehouse for fittings are all located conveniently to the wharves. Standard gage railroad tracks and planked roadways for motor trucks are provided for the delivery of materials. From these shops fabricated materials will be delivered to the wharves by motor tractors.

Secondary Buildings

The sub-station and compressor house is located near one end of the plate and angle shop in such a position that it can furnish air to this shop and also for use at the ways with a minimum length of distributing lines. Motor-driven air compressors of 4,500 cubic feet capacity are installed in the compressor house, and are operated by 2,300-volt alternating current motors, taking current directly from the city distributing system. Motor generator sets are also provided in this building for furnishing direct current for crane and derrick service throughout the yard.

The main office buildings, timekeepers' office, change houses for the workmen and a hospital are conveniently located near the main entrance of the yard, which is placed so that the workmen will have a minimum distance to travel after entering the yard to reach their work.

At present there are three building ways, but space has been left and the whole layout arranged so that five additional ways can be installed. There is also room for the construction of a complete repair yard with drydock facilities.

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The Foundation Company is building at this yard for the French Government five 4,250-ton deadweight steel cargo steamers of the Le Parmentier "unsinkable" type.

LE PARMENTIER "UNSINKABLE" TYPE SHIPS

Unlike previous designs, which involve modifications of a standard cargo steamer, the Le Parmentier design makes a radical departure from usual forms of ship construction. As will be noted from Fig. 3, the general external appearance of the vessel resembles the whale-back steamers which have been operating successfully for many years on the Great Lakes. The cross section of the vessel, however, instead of being of the usual U-shape, is in the form of two circles side by side, connected above and below by curved segments (see Fig. 4).

The hull consists of two parallel cylinders 20 feet in diameter, arranged horizontally side by side and connected by transverse watertight bottom and deck, as shown in the cross section. The cylindrical form not only gives maximum strength, but also provides double inner longitudinal walls to localize flooding of the hull if the outer skin is ruptured.

The entire hull is stiffened and given further protection from flooding by seven watertight bulkheads (shown dotted on deck plan, Fig. 3). These bulkheads being continuous from side to side form watertight compartments in each of the cylinders and in the "reserve buoyancy" space between them. The hull is thus subdivided into twenty-four separate watertight compartments.

The general dimensions of the steamers now under construction are: Length overall, 328 feet 4 inches; length on load waterline, 314 feet 9 inches; beam, 46 feet 5 inches; draft (maximum), 16 feet 1½ inches.

The propelling machinery will consist of twin triple-expansion, 700-horsepower engines, designed to give the vessel a speed of approximately eight knots loaded. Steam will be supplied by Scotch boilers fired with oil fuel. As one complete power plant is installed in each half of the hull, the vessel can be brought into port even though one side has been completely flooded.

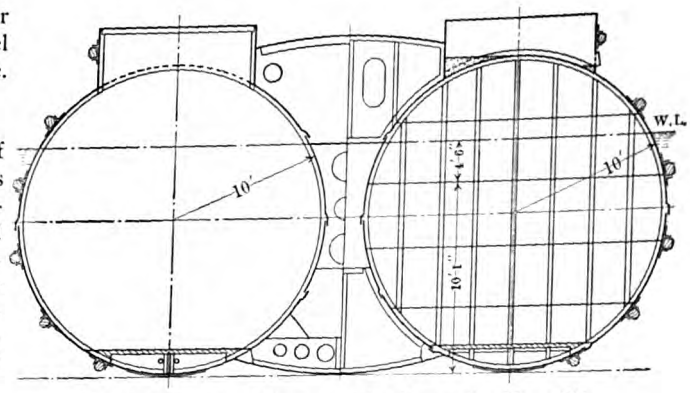

Fig. 4.—Transverse Section of Le Parmentier Type Ship

The vessels are being built under the inspection of the "Bureau Veritas." According to the present schedule, the first hull will be launched early next summer.

OTHER FOUNDATION YARDS

The New Orleans yard is the largest of the three steel shipbuilding plants controlled by The Foundation Company, the other two being located at Savannah, Ga., and Port Huron, Mich.

The Foundation Company's experience in shipbuilding began in July, 1917, when it laid the keel of a 3,500-ton Ferris type ship for the Emergency Fleet Corporation. Since then it has completed forty wooden auxiliary schooners and fifteen cargo steamer hulls, with a total deadweight capacity of 169,000 tons—a greater production than is credited to any other wooden shipbuilding organization in the country.

The executive heads of The Foundation Company are Franklin Remington, president, and John W. Doty, vice-president. All construction is under the supervision of H. J. Deutschbein, general manager, with C. A. D. Bayley and Bayley Hipkins vice-presidents in charge of shipbuilding on the Atlantic and Pacific coasts respectively. Hewitt Crosby is manager of the New Orleans shipyard.

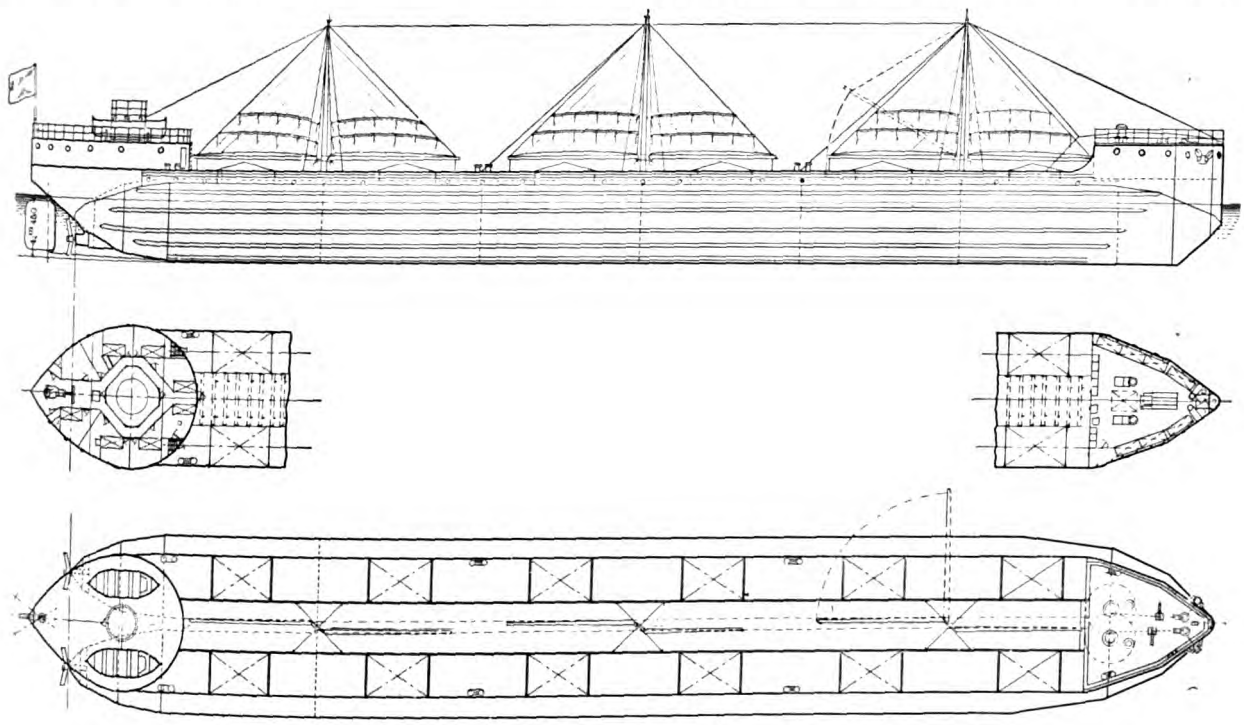

Fig. 3.—Le Parmentier Type of "Unsinkable" Steel Ship

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Fig. 1.—View of Carolina Shipyard, Showing Outfitting Pier in Course of Construction; Sheet Metal and Blacksmith Shops; Pipe and Coppersmith Shop; Carpenter and Joiner Shop; Power House; Storehouse. In the Background Are the Derrick Towers at the Four Shipways

Carolina Ship Building Corporation

New Yard Erected for Building Emergency Fleet Vessels —Contract Calls for Twelve 9,600-Ton Cargo Ships

THE United States Shipping Board Emergency Fleet Corporation entered into contract with the Carolina Ship Building Corporation on April 17, 1918, by which the Carolina Ship Building Corporation, acting as superintendent for the Fleet Corporation, was to construct a shipyard plant at Wilmington, N. C., and also twelve 9,600-ton deadweight capacity steel cargo steamships.

The general scheme involved the fabrication of the midship section of the hulls (about 55 percent of the total tonnage of the hulls) in bridge and structural shops, and the fabrication of the molded or fore and aft ends of the hulls in the new yard, and the purchase, outside, of the engines, boilers, pumps, condensers and all such mechanical and some other features.

The plans of the yard were prepared by the Carolina Ship Building Corporation and provided for four shipways, fabricating shop, mold loft, sub-station and compressor house, machine and pipe shop, blacksmith shop, sheet metal shop, carpenter and joiner shop, outfitting pier, storehouse, time-keeping office, outside superintendents' office, first-aid hospital, mess hall and administration building.

Location of the Yard

The yard is located on the east bank of the Cape Fear River, about three miles south of the business center of the city of Wilmington, and about twenty-three miles from Cape Fear lighthouse at the mouth of the river. There is a 26-foot depth of channel, dredged and maintained by the United States Government, from the sea to the northern end of the city waterfront.

The property, purchased by the Fleet Corporation of the Seamen's Friend Society and others, consists of 103 acres, with 1,800 feet of frontage on the river. A part of this property, about one hundred years ago, was the site of a hospital used in connection with a plague that the city suffered, and during the Civil War the same point was the site of the Confederate Fort Lee. The fence surrounding the shipyard encloses about 48½ acres and takes in 1,150 feet of the waterfront.

The first survey party arrived on the property on April 18, 1918, and the first earth was moved and actual clearing for construction work commenced on May 28.

Change in Plans

The original plans located the outfitting pier at the south side of the yard, with the shipways to the northward. In June the Fleet Corporation ordered the construction of the yard after a plan that would provide for the ultimate construction of eight shipways. The shipbuilding corporation and the resident representative and plant engineer of the Fleet Corporation then prepared revised plans for the yard on that basis. The waterfront topography to the north of the northernmost of the four ways was low and boggy, and it was found that the most economical plan for the eight-way plan was to transfer the outfitting pier from the southerly to the northerly end of the property, even at the expense of abandoning the piles that had already been driven for the outfitting pier at the original site. Only about one-half of the total number of the piles for this pier had been driven, and if the G and H ways are built these piles can be used to form a pier which will be quite useful.

A short time after this a verbal order was given to the shipbuilding corporation to build a total of six ways instead of four ways, as originally planned. The construction was carried on until October 15 on this plan, but on that date the order for the two additional ways was cancelled. This cancellation, of course, not only affected the two additional shipways, but other features of the plant that had been added to balance the production.

The plant construction, with the exception of the under-

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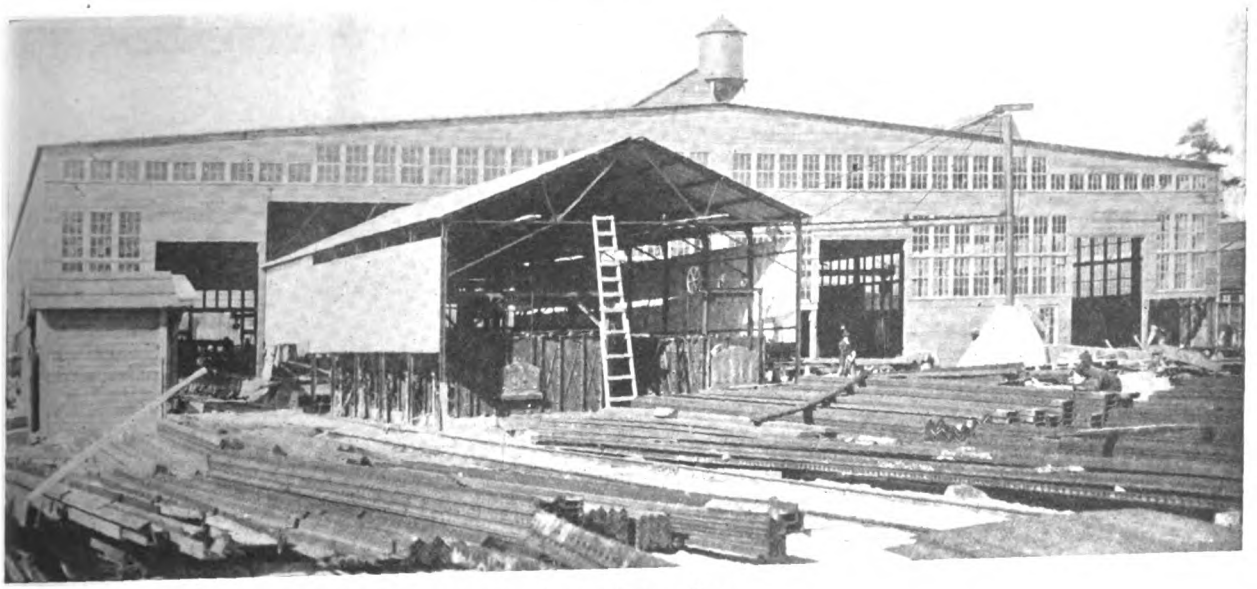

Fig. 2.—Fabricating Shop

water portion of the shipways, was completed on February 15, 1919.

Railroad Connections

It will be observed that the railroad tracks enter the yard at the northeast corner. The tracks are the property of the Tide Water Power Company, the local public utilities concern. For a distance of about two miles from the shipyard to a junction with the belt line of the Atlantic Coast Line Railroad, the line of the Tide Water Power Company is double-tracked. Both of these tracks are used by the electric cars of the power company for transportation of the yard employees during the rush hours in the morning and evening, and one of the tracks is used by the steam locomotives of the shipyard for freight service during the other hours.

The steel plates, shapes, etc., to be fabricated in the yard

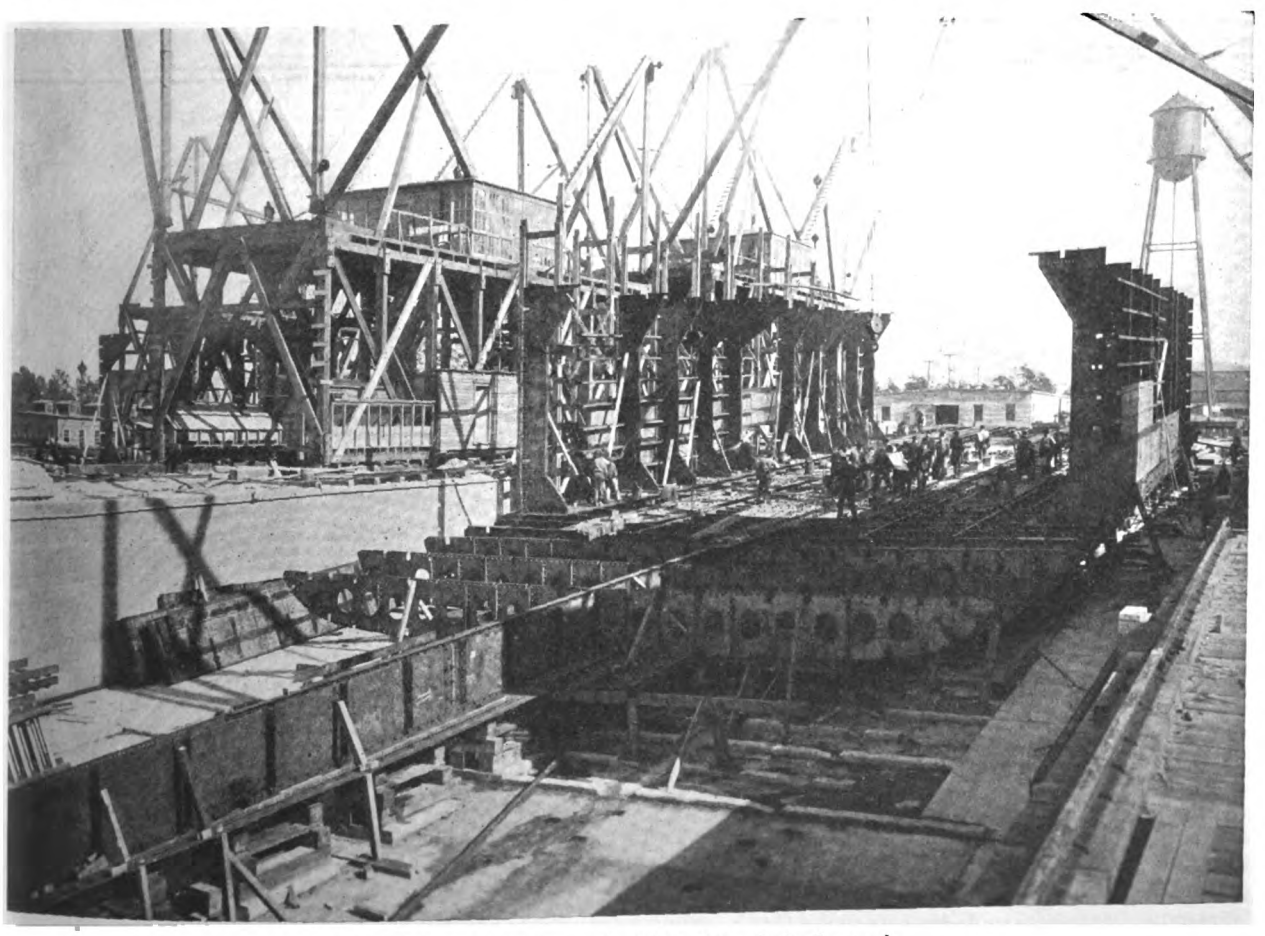

Fig. 3.—Riveters Working on the Hull of the S. S. *Cranford*

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are unloaded and stored to the east of the fabricating shop. Plates are placed on edge in racks; shapes, universal mill plates and bars are piled.

Storage of Materials

Hull steel, fabricated outside, is unloaded and stored adjacent to the tracks from the entrance to the yard to the curves toward the river, between the mold loft and the fabricating shop, to the south of the fabricating shop and in front of the ways. Racks are provided in the triangular spaces between the tracks in front of the ways for plates that come to the yard punched by the outside fabricators.

Outfitting materials and equipment are unloaded and stored along the tracks leading from the entrance to the outfitting pier or stored in some of the buildings of the outfitting department, or in the storehouse, depending on the nature of them.

Yard Crane Equipment

Locomotive cranes are used for all yard work, unloading, storing and re-loading. The total length of tracks in the yard is about six and a half miles. The rails (67.5 pounds per yard), splices, bolts and spikes are Russian Government railway standard, rolled in the United States on Russian order. They have given good service and are said by those who built and are maintaining the tracks to have several points of merit.

The two crane runways, located east and west of the fabricating shop, are to be installed when the second fabricating shop is built.

The mold loft is 80 by 250 feet, steel frame, with wood and glass sides and ends, and wood sheathing and paper roof, and white pine floor.

Adjacent to the mold loft is a specially designed building of frame construction for the storage and care of all templates.

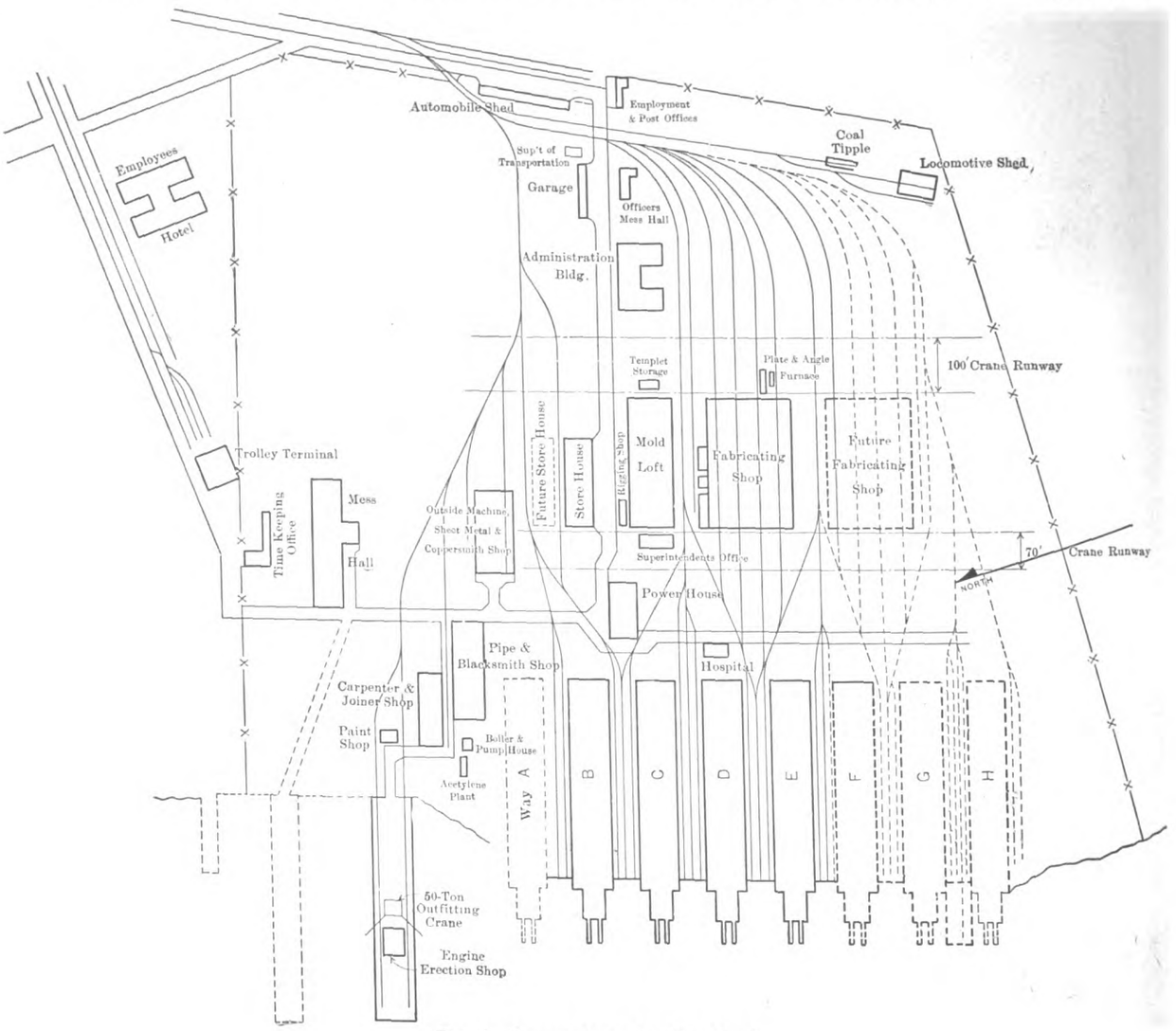

Fig. 4.—Layout of the Carolina Yard

Fabricating Shop

The fabricating shop is 160 by 250 feet, steel frame, with wood and glass sides and ends, and wood sheathing and paper roof. All the roof trusses are designed with bottom-chords of two channels forming tracks for electric overhead hoists running the full width of the shop. All transverse movements of material are therefore made with the electric overhead hoists, operated from the floor, and the longitudinal movements are made on buggies with roller-bearings on the four standard gage tracks which run the full length of the shop. The equipment of this shop includes a plate furnace, an angle furnace, a rivet-making machine, a set of bending rolls 30 feet between

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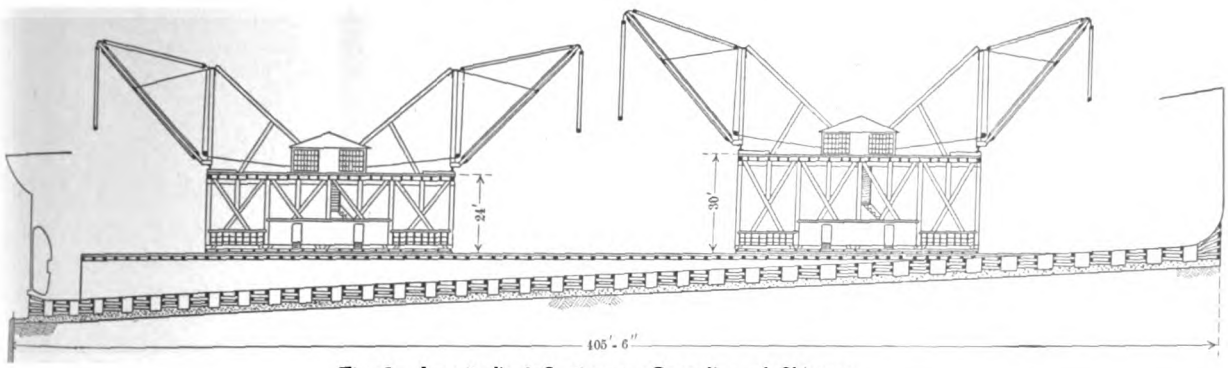

Fig. 5.—Longitudinal Section on Centerline of Shipway

housings, and the usual shears, punches, drills, reamers, riveters etc. Material after fabrication in this shop is taken direct to the shipways or stored in the space shown outside of the west end of the shop. The floor of this shop is of untreated wood blocks 6 inches long cut from the stumps and butts of trees cut in the clearing of the yard site. Located near the fabricating shop is a small, especially arranged building for the storage of gas tanks and for the repair and storage of gas-burning and welding torches.

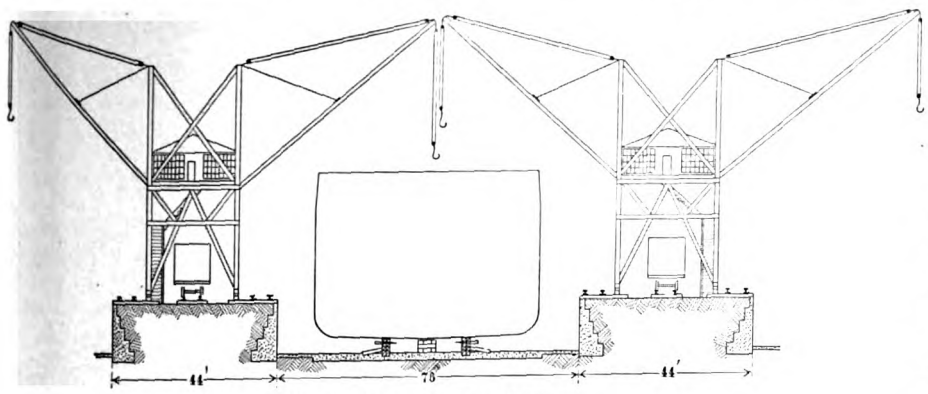

Fig. 6.—Cross Section of Shipway

Shipways Built of Concrete

The shipways are of concrete construction on sand and rock foundations, with concrete retaining walls forming the sides of the docks between the ways. On each dock there are two wood derrick towers, movable on rollers, and each of the towers carries four derricks with 56-foot booms and electric hoists. It will be seen by the sketch, shown in Fig. 6, that the general elevation and profile of the property suggested this type of construction, the cost of which was less than that of the usual pile shipway above ground. The cost of maintenance will certainly be far less and the fire risk is reduced to the very minimum.

Adjacent to and facing the ways is the air tool storage and repair shop, where all air tools used on the ways and in the shops are stored and put in repair.

Power Requirements

Electric power, 11,000 volts, 3-phase, 60-cycle, alternating current, is purchased of the Tide Water Power Company and delivered by them to the transformers at the sub-station or power house shown on the plan. The power house equipment consists of an electrically operated switchboard, alternating current transformers, rotary converters for direct current, three electrically direct-driven air compressors, each of 2,275 cubic feet per minute capacity, and one electrically belt-driven air compressor of 1,200 cubic feet capacity per minute. The electrician's storeroom and workshop are located in this building. The building has concrete walls and concrete roof.

The storehouse walls and floor are of concrete with slow-burning wood construction roof supported on steel beams. It is 162 feet long, divided into ten separate fire-

Fig. 7.—Employees' Hotel at Carolina Shipyard; Housing Capacity, 150 Men

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proof compartments by concrete cross-walls 16 feet apart, center to center.

Equipment of Machine Shop

The machine shop is 153 by 71 feet, of wood construction. While the principal engineering and mechanical equipment for the ships will be purchased outside, some machine shop capacity is provided for making corrections and alterations and for finishing many of the pieces of equipment that will be made in the yard. The machine shop equipment consists of six lathes of different sizes, two shapers, power saws, two radial drills and other tools of such a nature as to make the shop one of the most complete. There is also included a specially designed boring bar for the boring of the stern frames and tubes.

The pipe shop is equipped to fabricate all of the pipe work for the ships and contains, in addition to the hydraulic bending machine, pipe flanging machine and heavy cast iron bending floor, pipe cutting and threading machines and all other small equipment necessary for the handling of all sizes of pipe required on the vessels and in the plant. In addition, these shops will take care of all of the plant maintenance and upkeep work in their lines.

Blacksmith and Forge Shop

The blacksmith and forge shop is 181 by 60 feet, of wood and steel construction. The principal equipment is one 800-pound and one 1,100-pound steam hammer, and one 200-pound Bradley cushion hammer. In the same building is the sheet metal and wire working shop, with full equipment for the handling of all light pipe and sheet metal work required on the boats. In this building there is also located an electric galvanizing plant for galvanizing the many parts of the ships requiring this treatment. In another corner of this same building is the copper shop, equipped for the making of all copper piping and sheet copper work as may be required.

Separate from, but near the machine shop, is the pattern shop, which is replete with all necessary tools and equipment for the making of the finest patterns.

Carpenter and Joiner Shop

The carpenter and joiner shop is 136 by 46 feet, of wood construction, with tools and equipment to care for all ship carpenter work. The joiner work may be sub-let to other contractors, but if not, this shop will be equipped to do all of the work under that heading.

Other features are a 40,000-gallon steel tank on a steel tower 100 feet high. River water, used for fire protection and steam, is pumped to this tank by a duplex steam pump of 1,000 gallons capacity located in a fireproof building adjoining the boiler house on the river bank. The river water is fresh, and, except after a long, unusual drought, is excellent for steam purposes.

Adjoining the pump house, and also on the river bank, is the plant for making acetylene gas.

Outfitting Pier

The outfitting pier is 75 feet by 425 feet, of wood pile construction and wood decking. For heavy work there is a double stiff-leg derrick, each boom of a capacity of fifty tons. The light outfitting materials will be handled by locomotive cranes operating on the side tracks on the pier.

Welfare Features

The mess hall for the yard men is 240 feet by 57 feet, of wood construction. The west end is for the whites and will seat 1,025. The east end is for the colored and will seat 382. There are separate kitchens for each. The service is cafeteria.

The first aid hospital is 15 feet by 40 feet, of wood construction with concrete floors. It is equipped with two wards, an operating room and an office. The company carries its own insurance, and a surgeon and the accident manager are in attendance during working hours. Prompt service is given by the Walker Memorial Hospital of Wilmington, which maintains automobile ambulance service.

The time-keeping office at the eastern entrance has been used during the period of plant construction, but as soon as the trolley tracks are completed to the northern entrance the time-keepers will be established at that point, and that will be the entrance and exit used by all of the yard employees except the office force. Transportation service for the yard force will be to and from that entrance at the rush hours, but at other hours it will be to and from the eastern entrance. The former time-keeping office will then be used as a sub-station of the Wilmington post office, which has been established as a convenience for the shipyard and for the individuals employed there.

The restaurant for office employees is 62 by 24 feet, of wood construction. It seats eighty-eight.

The superintendents' office building is 32 by 71 feet, and in it are the offices of the outside foremen on ship construction and several others.

Located in the southeast corner of the enclosure is the locomotive house, 111 by 25 feet, of frame construction, for the housing and care of the company locomotives.

Administration Building

The administration building is U-shaped, 128 feet across the front, or north side, and each wing is 88 feet deep. The width of all the wings is 40 feet. On the first floor there is a hall 7 feet 6 inches wide running through the front and west wings, with offices on either side. The Fleet Corporation representatives occupy the entire east wing, first floor. The second floor contains the drafting room, covering the entire front wing, and the rest of this floor is devoted to offices, blue-print room and women's rest and retiring room.

Located near the administration building is a garage of frame construction 16 by 100 feet for the proper storage of the company cars, and immediately adjoining is the workshop where the cars are overhauled and kept in first-class repair.

The boiler house contains two 125-horsepower Erie boilers to furnish steam for fire pump, operation of steam hammers and blacksmith shop, and steam on the outfitting pier.

Employees' Hotel

The employees' hotel, just outside the fence, is of wood construction and has ninety-eight sleeping rooms, each 9 by 12 feet, opening on an outside porch, a living or assembly room 24 by 47 feet, quarters for the caretaker and his family, and tub baths, shower baths, toilets and washing fixtures. This is owned by the Fleet Corporation and will be operated by the shipbuilding corporation.

Domestic water for the entire plant is furnished by an artesian well 135 feet deep located in the shipyard.

The climate is ideal, never so cold as to interfere with out-of-doors work, and, while hot in the sun during the summer, it is very seldom that there is not a delightful breeze that overcomes the heat.

The Carolina Ship Building Corporation designed and built the entire plant with its own forces.

Type of Ships Under Construction

The present contract calls for the construction of twelve single-screw steel cargo vessels, to be built under special

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survey to 100 A-1 Class of Lloyd's and constructed, equipped and fitted to meet all requirements of the United States Steamboat Inspection rules.

The general dimensions are:

Length between perpendiculars.....	395 feet 6 inches
Breadth, molded.....	55 feet
Depth, molded to shelter deck.....	34 feet 11 inches
Height of between decks at side.....	7 feet 11 inches

The vessels are to carry 9,600 tons deadweight, including cargo, reserve feed water, fuel and stores, on a maximum draft of twenty-seven feet. They will be built on the Isherwood system of longitudinal framing and will have two complete steel decks with raised poop, bridge and forecastle.

There will be two steel cargo masts, with four 5-ton cargo booms on each mast, and one portable 30-ton boom installed for use on either mast. Two derrick posts, one on either side midships, will also be installed for handling coal for the large 'thwart-ship bunker. There will be four main cargo hatches, two forward and two aft, with four cargo winches located between each pair of hatches. There will also be one cargo winch on the poop and one on the bridge deck, which will operate the derrick post booms.

Hull Construction

A double bottom, 4 feet 3 inches in depth, will extend from peak to peak, the portion under the machinery space to be used for feed water and the portions fore and aft the machinery space to be used for either cargo oil or water ballast.

The coal bunker, which is directly forward of the fireroom bulkhead, will be twenty feet in length and will extend across the full width of the ship below the shelter deck. There will be additional coal bunker space between the shelter and bridge deck, which will bring the total capacity of bunkers up to 1,450 tons.

There will be five watertight bulkheads between the fore and after peaks. The peak bulkheads will be oiltight, to allow these spaces to carry oil when necessary.

The stern frame is to be of cast steel in four sections: the rudder, one solid steel casting. Accommodations will be provided in the steel deck houses amidships for all officers', stewards' and cooks' departments. Accommodations for the crew will be under the poop deck aft. Under the forecastle deck forward will be the hospital, carpenter shop and rooms for paints, lamps, stores, etc. The chart room will be located on the flying bridge, with wireless room located in the after end. The refrigerating outfit, of two tons' capacity, and all necessary cold storage rooms will be located on the starboard side at the after end of the center house between the upper and shelter decks.

There will be one boat deck amidships, on which will be stored two 26-foot lifeboats and one metallic life raft for seventeen persons, as well as one 16-foot working boat. There will also be two 26-foot lifeboats on the poop deck. All lifeboats will be operated by the Steward mechanical davits and releasing gears.

Propelling Machinery

The machinery will be located amidships and will consist of one triple-expansion engine of 2,800 indicated horsepower and three watertube boilers equipped to burn coal and built for working pressure of 200 pounds, in addition to the auxiliaries necessary for this plant.

The electrical equipment will be cared for by two General Electric generators. The steam steering engine, with hand gear attachment, will be located under the poop deck aft and will be controlled from the pilot house by an electric telemotor.

The vessels and their machinery are designed for a sea speed of eleven knots. They will be constructed and fully equipped ready for sea at this yard.

Progress of Construction

The first four ships are now well along in their construction. The midship portion of the hull is being fabricated at Roanoke, Va., and while this portion is being erected the end sections are being fabricated at this plant. All of the work is progressing in such a manner as to warrant the launching of the first vessel about May 1, and the remaining ships should follow along at short intervals thereafter. As each vessel is launched she will be placed in the wet basin for the installation of machinery and final equipment, which will occupy about two months' time after launching for completion of each vessel.

Standard Sea-Going Cargo Vessel of 3,500 Tons Deadweight Built on the Lakes

(*Concluded from page 207.*)

sequence of cranks is high pressure, low pressure, intermediate pressure. The main condenser, which has a cooling surface of 1,562 square feet, is built into the engine framing. The main circulating pump is of the centrifugal type, with 8-inch suction and discharge, driven by a single-cylinder, 6-inch by 6-inch reciprocating engine. The air pump, attached to the main engine and driven off the low pressure crosshead, is of the Edwards type, with a capacity of about 5,100 cubic inches. Two 3½-inch by 20-inch single-acting feed and bilge pumps are also attached to the main engine and driven off the low-pressure crosshead.

The auxiliary pumps include:

One auxiliary feed, vertical duplex type, 7½ inches and 4½ inches by 10 inches.

One ballast, horizontal duplex type, 7½ inches and 8½ inches by 10 inches.

One fire bilge and general service, vertical duplex type, 7½ inches and 4½ inches by 10 inches.

One evaporator feed, horizontal duplex type, 3 inches and 2 inches by 3 inches.

One sanitary, horizontal duplex type, 4¼ inches and 3¾ inches by 4 inches.

One circulating pump for refrigerator coils and distiller, horizontal duplex type, 4½ inches and 3¾ inches by 4 inches.

One fresh water pump, horizontal duplex type, 4½ inches and 3¾ inches by 4 inches.

The auxiliaries also include a feed water heater; an evaporator designed to produce 15 tons of fresh water per twenty-four hours, using steam at not over 50 pounds pressure; an auxiliary condenser, and a feed filter.

Reinforced Concrete Steamer Armistice.—The first large self-propelled sea-going reinforced concrete vessel to be built in Great Britain, the *Armistice*, was launched by the Ferro-Concrete Ship Construction Company, Barrow-in-Furness, early in January. The vessel is a single-deck cargo steamer of about 1,150 tons deadweight, 205 feet long between perpendiculars, 32 feet beam, molded, 19 feet 6 inches depth, molded, and, with steam propelling machinery of about 400 indicated horsepower, is to have a speed of about 7¾ knots. The hull is built on the monolithic principle and has two holds with the machinery aft. The main engine is of the compound surface condensing reciprocating type, having cylinders 15½ inches and 33 inches diameter by 24 inches stroke supplied with steam at a working pressure of 140 pounds per square inch by two cylindrical boilers 9 feet 6 inches diameter by 9 feet long.

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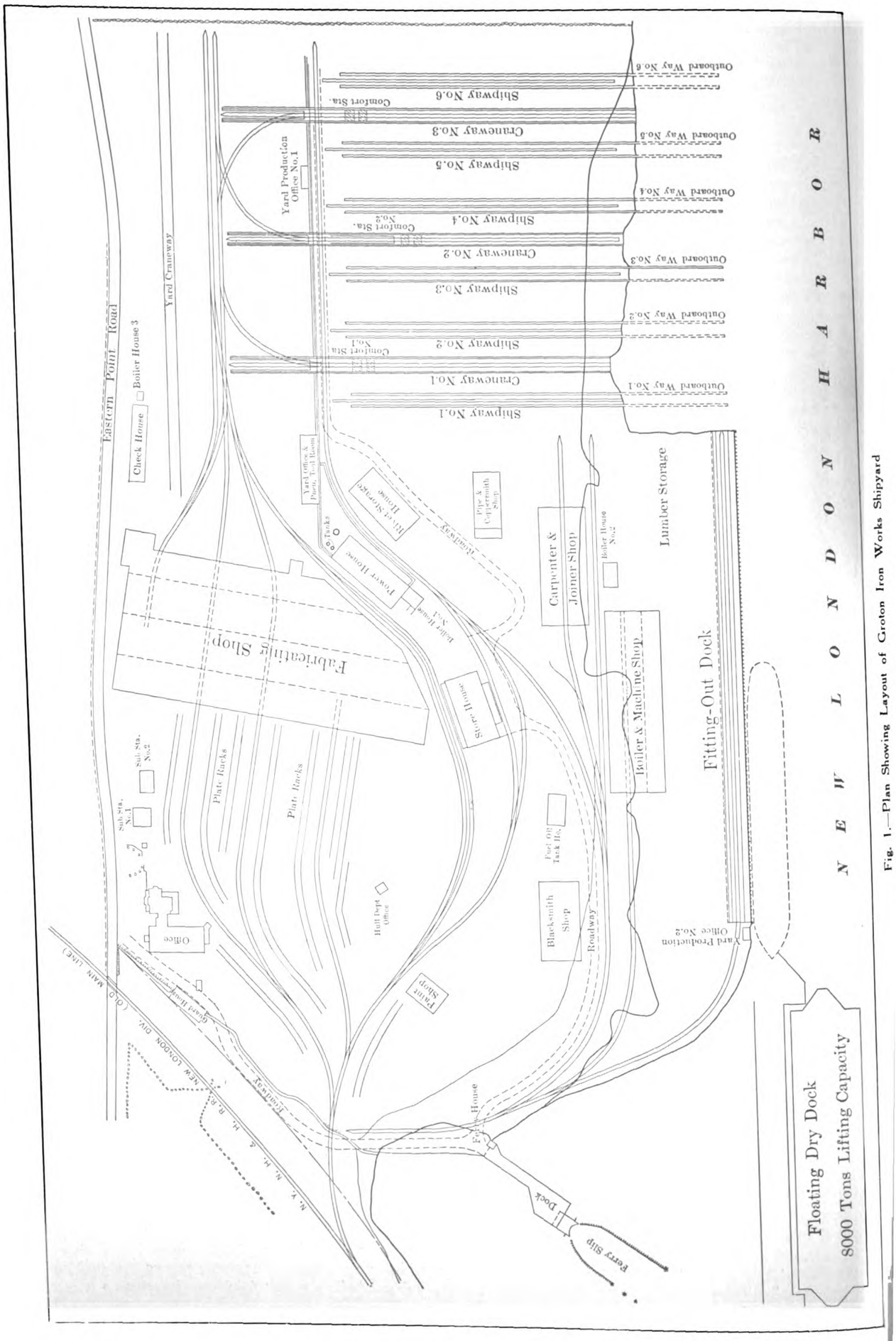

Fig. 1.—Plan Showing Layout of Groton Iron Works Shipyard

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Fig. 2.—Six Terry Tower Cranes on the Three Concrete Craneways Handle Material at Shipways. Sub-Assembly Area for Bulkheads and Deck Houses in Foreground

Groton Iron Works Shipbuilding Plant

Latest Ideas Embodied in Layout and Construction of Modern Steel Shipyard—Six Launching Ways Provided

TO meet the need for more ships, the Groton Iron Works, Groton, Conn., in April, 1917, purchased twenty-six acres near the mouth of the Thames River, opposite the city of New London in the heart of a summer colony, for the erection of a steel shipyard. This is an ideal location. A granite ledge runs about 6 feet below the surface of the ground and outcrops at the water's edge. The river at this point is 30 feet deep 800 feet from the shore, and 21 feet 200 feet from the shore, hence no dredging has been necessary for launching purposes.

The layout of the yard combines the best features of various yards throughout the country. Material enters at the north end of the yard from a spur of the New York, New Haven & Hartford Railroad to the storage yard and storehouses. There is a capacity for storing 18,000 tons of raw steel, or enough room for steel for six ships.

Method of Handling Material

The steel as needed is loaded by McMyler locomotive cranes on railroad cars and taken to the plate and angle shop to be punched. Here the steel is handled by Erie and Northern overhead electric traveling cranes to the laying-out tables and to the Lysholm tables for the punches, and again loaded on railroad cars. On these cars are built racks which carry plates in the center and shapes on the side. A greater weight can be carried in this way, and it is possible then to pick out the piece wanted first when the car arrives at its destination. The steel then goes to finished steel stores or to ground assembly spaces or direct on the craneway for erection.

Concrete Shipways

The yard has three concrete craneways and six end-launching concrete shipways. The shipway consists of a central keel blockway and two launching ways; all are of concrete rectangular cross section built on ledge rock. The ways have a slope of 5/8 inch to the foot. Each of the six building ways can now take vessels up to 450 feet long and 60 feet beam. All ways can easily be lengthened to take 500-foot ships.

There are six Terry hinged-boom traveling revolving tower cranes now in operation on the craneways. These cranes are capable of lifting 5 tons at a radius of 87 feet and 13 tons at 52 feet at a speed of 65 and 48 feet per minute, respectively. One complete revolution is made in 1½ minutes. The travel speed is 250 feet per minute.

In testing the cranes, loads 25 percent in excess of those specified were used. The booms are constructed of structural steel shapes and are of the locomotive crane type, approximately 7 feet wide at the base.

The structural steel masts are equipped at their lower ends with the Terry hemispherical mast step and foot blocks, designed to develop the resultant horizontal and

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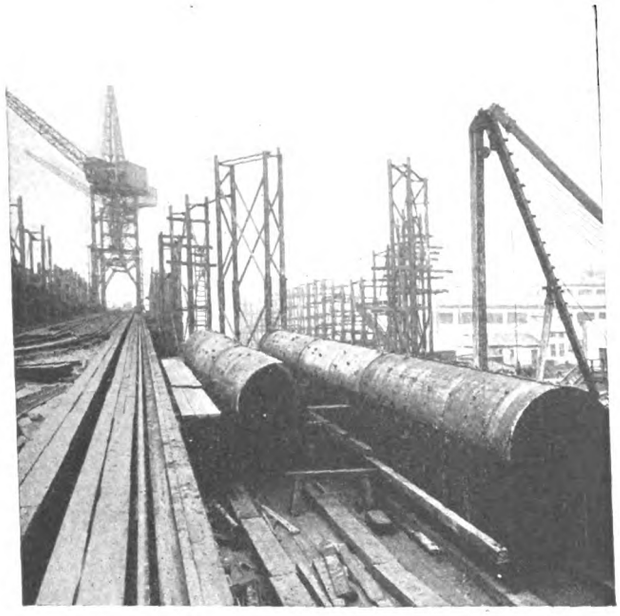

Fig. 3.—Showing Ground Assembling of Shaft Alley

vertical forces at this point. Some of the cranes have a tower 53 feet high, others 68 feet, and are designed for running on rails 18 feet center to center, with a portal providing 20 feet vertical clearance.

The upper ends of the towers are equipped with cast steel ring gears machined on their inside to take the thrust of the mast rollers. The bottoms of the towers are fitted with eight M. C. B. cast iron double-flanged chilled tread wheels 28 inches diameter arranged in pairs.

The main falls are composed of four parts of ⅝-inch 6 by 19 plough steel rope reeved through one 14-inch single metaline bushed block with shackle, and one 14-inch double metaline bushed block with swivel hook and cheek weight for overhauling. The boom falls are of seven parts of ⅝-inch 6 by 19 plough steel reeved through two 14-inch triple metaline bushed blocks with shackles.

The main hoists are equipped with a 65-horsepower, 230-volt, direct-current General Electric motor of the double-friction drum type with band brake and non-reversing mechanical brake. The swingers are equipped with 15-horsepower, 230-volt, direct-current motors driving through proper gear reductions. They are equipped with solenoid brakes.

The crane travel drive is equipped with 65-horsepower, 230-volt, direct-current motors with proper gear reductions and solenoid brakes. The controls are so placed as to give the operator a clear view of his work at all times, banked in a quadrant. The approximate weight of each crane is 215,000 pounds.

Ground was broken for the construction of the Groton plant in August, 1917. On August 11, 1917, a contract was signed with the United States Shipping Board Emergency Fleet Corporation to build six steel cargo steamers of 8,800 deadweight tons each. These vessels are of the *Robert Dollar* type, with length overall 423 feet 9 inches, beam (molded) 54 feet, depth (molded) 29 feet 9 inches, load draft 24 feet 1 inch, speed 10½ knots. They are built on the longitudinal framing or Isherwood design.

On April 20, 1918, another contract was signed for six

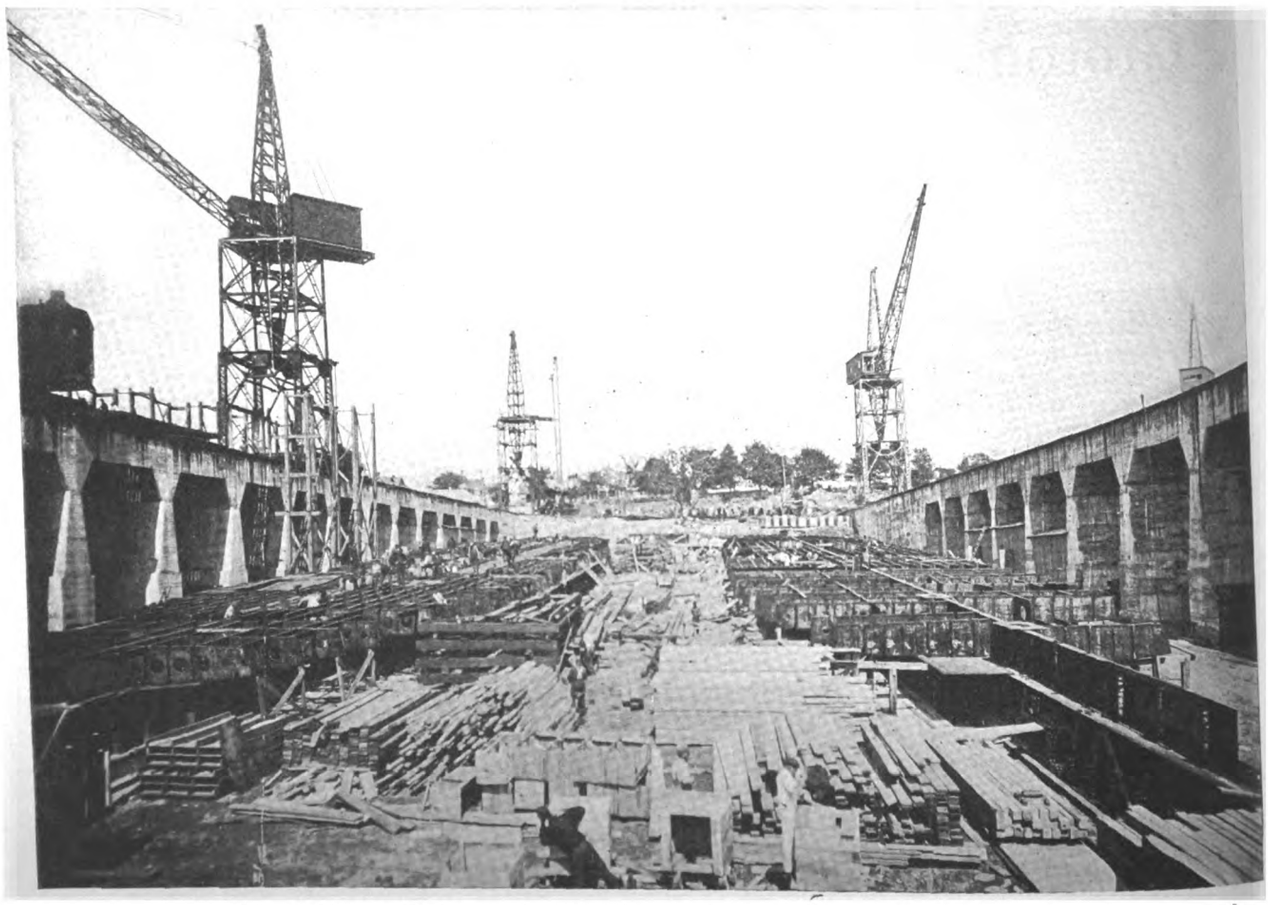

Fig. 4.—Two of the Concrete Shipways, Showing Construction of Concrete Crane Runways

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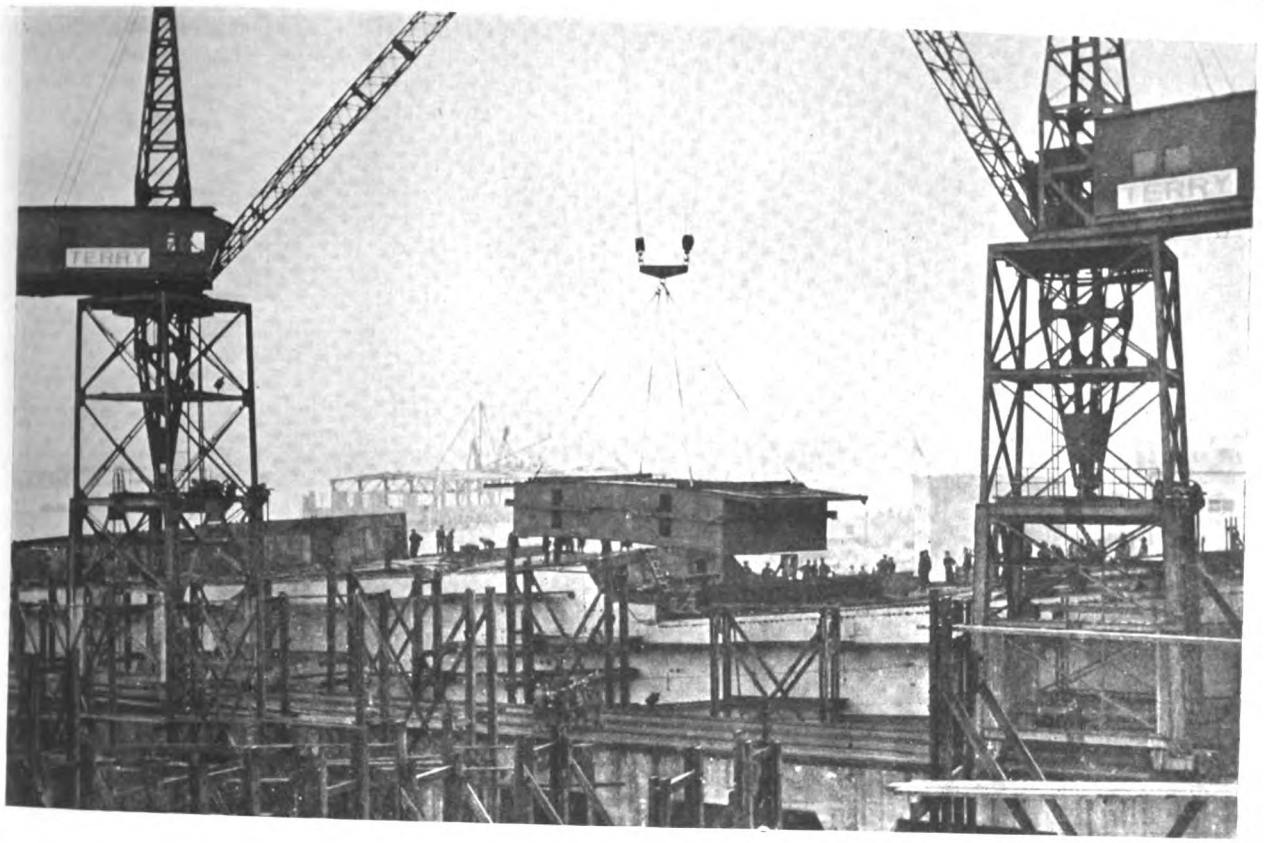

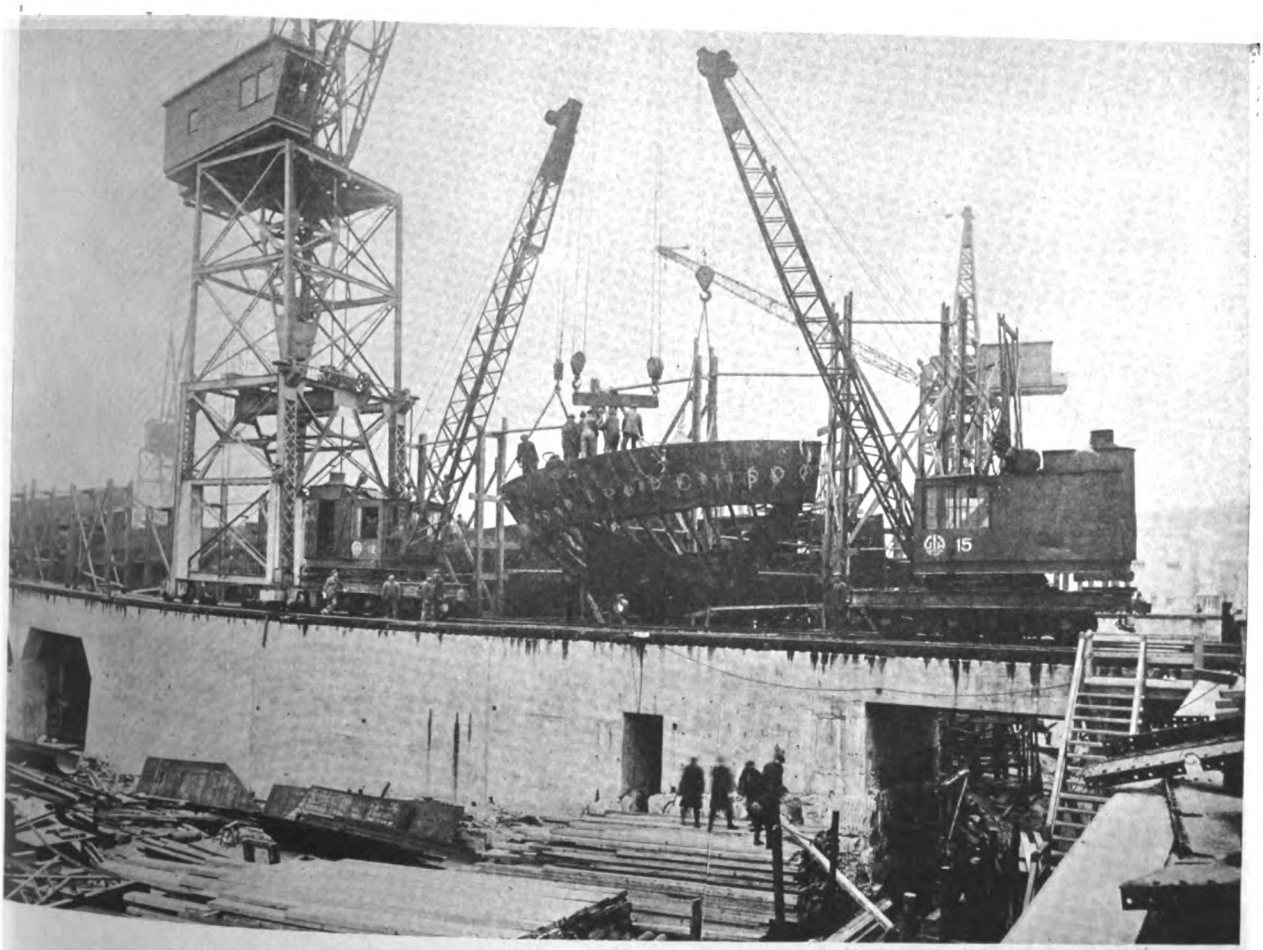

Figs. 8 and 9.—Method of Erecting Deck House and Fantail Assembled on the Ground

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additional ships of the Isherwood type of 9,400 tons deadweight capacity; length overall 417 feet 3 inches, beam (molded) 53 feet, depth (molded) 26 feet 6 inches, load draft 26 feet 4¾ inches, speed 10½ knots.

RECORD CONSTRUCTION

The keels of seven ships have been laid, the first one January 28, 1918. The first ship was launched November 9, 1918. For a new yard to get its first ship off the ways in less than ten months is an accomplishment that speaks well for the ability and facilities of the builders. Besides

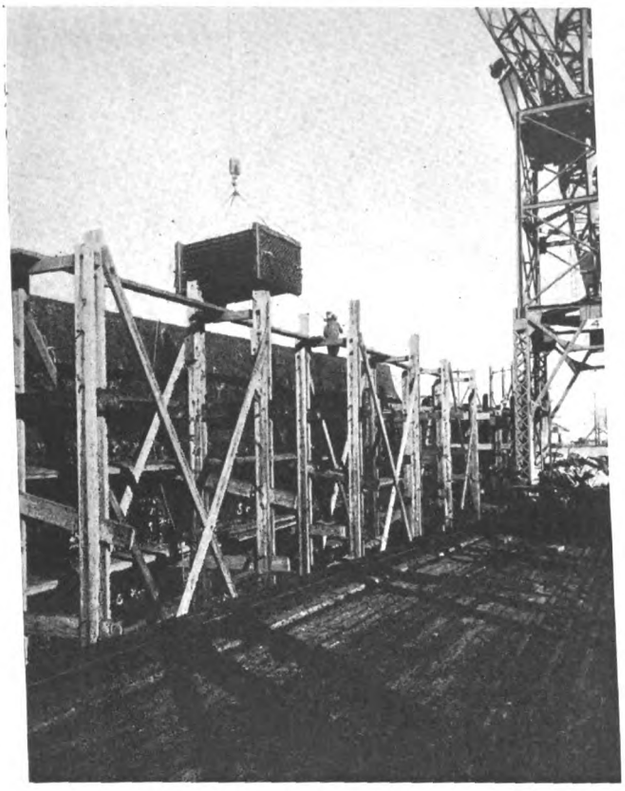

Fig. 10.—Placing the Boilers Aboard Long Before the Ship Is Launched

the work necessary and ordinarily required before launching, the following items are installed: Boilers, condensers, windlass, winches, main engine and auxiliaries, deck houses and fresh water tanks.

It is the policy of this company to do as much preassembly work as possible. For instance, the fan tail includes not only the transom and cant frames, but also part of the poop deck and the knuckle plates and shell on the counter. The deck house is placed on the ship complete.

The sizes of some of the principal buildings in the plant are as follows: Plate and angle shop (equipped with three "bull" riveters), 450 feet by 200 feet; mold loft (over plate and angle shop); boiler and machine shop, 300 feet by 80 feet; joiner shop, 170 feet by 70 feet; main stores, 150 feet by 60 feet; rivet stores, 100 feet by 50 feet; blacksmith shop, 120 feet by 60 feet.

Living conditions in New London are very congested, but are continually becoming improved. In this vicinity the Government has located a submarine base, an experimental station, Coast Guard defense and other activities. In spite of all this the number of employees has been increased 50 percent within the last two months. A training school under the Emergency Fleet Corporation is in full operation and is turning out reamers, shipfitters, riveters, bolters-up, chippers and calkers to meet the needs. The total number already trained is 170, and those under instruction now total 150.

The Employment Department is very much alive and does everything possible to keep the men interested and have them especially feel that this is their yard. The *Morse Code*, a semi-monthly paper, keeps everyone informed of what the other fellow is doing. An athletic team is formed in nearly every known sport, and great pride is taken in the band.

The company's organization is complete. As the superintendents and foremen are all men of long shipbuilding experience and among the foremost shipbuilders of the country, this yard should be one of the best shipyards on the Atlantic Coast.

Some Aspects of Large Diesel Cargo Ships

(*Concluded from page 219.*)

ment of this new industry, the importance of which is likely to reflect itself very pronouncedly in the future industrial and economical life of the nation.

In conclusion, certain tendencies which have recently made themselves felt regarding the method of drive for motorships call for some remarks here as far as this applies to heavy-duty work. Under the old, and, as usual, superficial one-sided arguments of lightest possible weight, the use of high-speed Diesel engines is recommended, combined either with reduction gears or electric drive; the latter, particularly, is supposed to be possessed of considerable advantages. As a matter of historical fact, it may be stated that the idea of Diesel electric drive is almost as old as the direct-reversible engine and has in at least two entirely independent cases been thoroughly tried out, with results which are quite evident to-day. The method has not been discarded so much on account of inherent difficulties as on account of failure to disclose any advantages, if combined with engines suitable for cargo boat service.

In every Diesel engine the rotative and piston speeds are fundamental quantities as well as qualities; they must satisfy not only given requirements as to output, but likewise bear a close relation to the life of the engine. The service to be rendered at once sets certain limits upon these speeds, and it is quite evident that steady operation under heavy loads demands lower speeds than where durability is sacrificed in favor of minimum engine weight and space. Continuity of operation and long life, aside from a favorable piston speed, dictate more liberally proportioned connecting rods and pistons than what is customary in high-speed engines, which means higher and stiffer frames and heavier cylinders. The reciprocating parts thus becoming heavier, more substantial proportioning of the crank shaft and bearings is the next desideratum. The rotative speed, partly dependent upon the weight of the reciprocating parts, must be kept within reasonable limits, as it also determines the very important relation of periodicity and reversal of stresses.

With all these points given due consideration, the installation of suitable Diesel electric sets cannot be accomplished within anywhere near the space or weight now required by high-grade, direct-reversible, low-speed engines directly connected to the propeller shaft. Owing to their mechanical simplicity, ease of operation, superior fuel economy and very materially lower cost, these are and continue to be the ideal solution for cargo boat propulsion.

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Fig. 1.—Laying the Keels for Steel Vessels at the Plate Yard

A Southern Shipbuilding and Repair Plant

Shipyard and Repair Facilities of the Alabama Dry Dock & Shipbuilding Company—Methods Employed in the Yards

BY G. F. S. MANN, B. S.

THE Alabama Dry Dock & Shipbuilding Company, Mobile, Ala., was formed in January, 1917, by Mr. D. R. Dunlap, the president. It was his intention to devote the activities of the company to a task which is of equal importance to shipbuilding in war times, namely, the repairing of ships. As a matter of fact, the company is building some ships for the Government, although its main energies are still being devoted to the repairing of ships.

The plants formerly owned by the Ollinger & Bruce Dry Docks Company, the Gulf Dry Dock Company, the Alabama Iron Works and the Gulf City Boiler Works have been united, and a large addition has been made to the company by the building of a complete unit on Pinto Island, where formerly there was only a 4,000-ton floating dry dock. At this point Pinto Island forms the east bank of the Mobile River. The property of the Alabama Dry Dock & Shipbuilding Company extends, with interruptions,

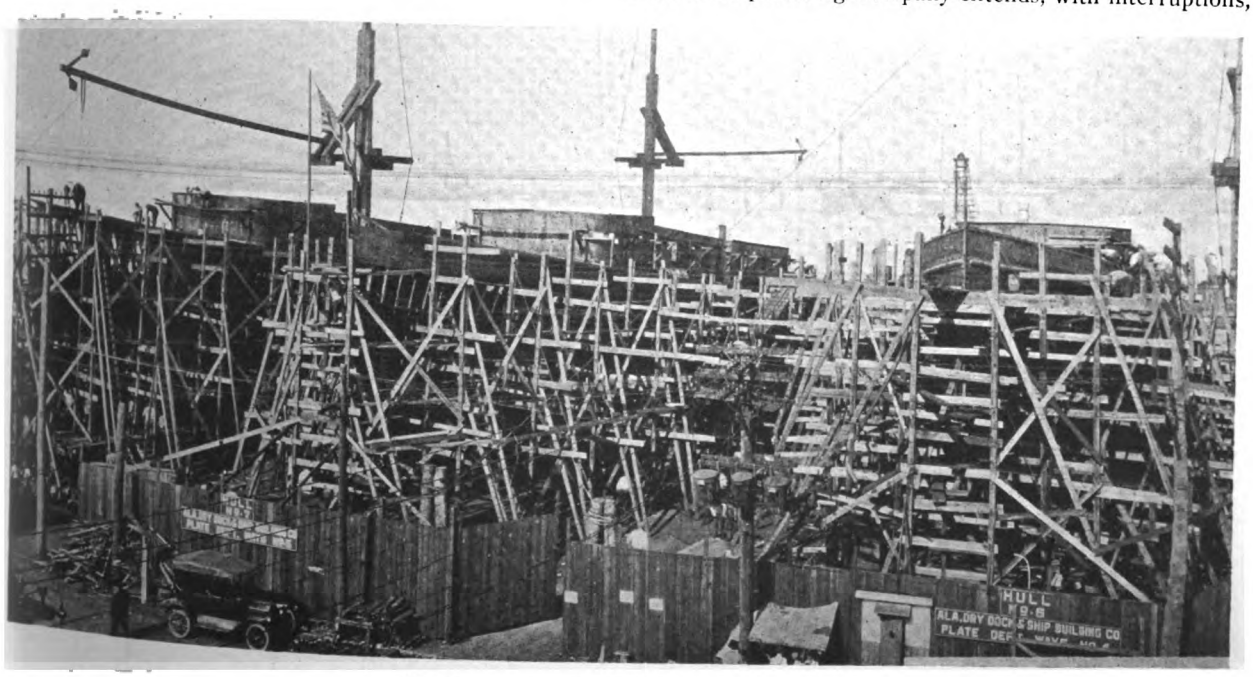

Fig. 2.—Steel Hulls Under Construction

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A SOUTHERN SHIPBUILDING AND REPAIR PLANT

Alabama Dry Dock & Shipbuilding Company, Mobile, Ala.

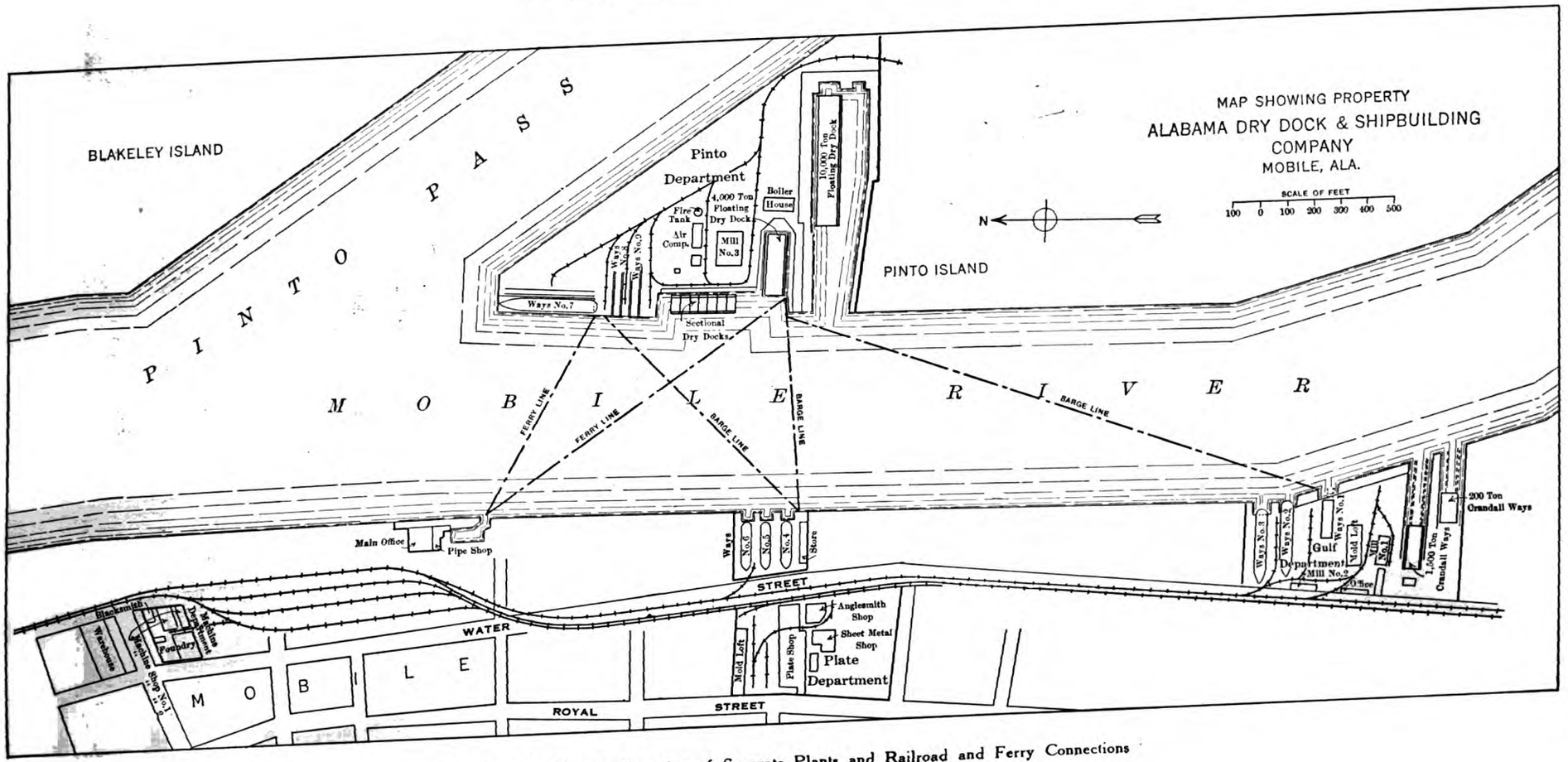

Fig. 3.—Map Showing Location of Separate Plants and Railroad and Ferry Connections

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for about a mile along the west bank of the Mobile River. The buildings and equipment formerly owned by the Alabama Iron Works are at the north end of the property and are the machine shops, blacksmith, foundry and pattern shops of the present amalgamation.

A short distance south of the machine department is the new general office building, containing the president's offices, the engineer departments and the auditing and accounting offices. At this point is a wharf 327 feet long, and from it passenger service is maintained to Pinto Island by motor launches. Here also is located the pipe-fitting shop of the company, and ships are moored at this wharf for finishing after the boilers and engines are installed. About three hundred yards south of the main office is the plate department, where the Gulf City Boiler Works formerly operated. This department has been very materially enlarged by the addition of a mold loft, a fabricating shop, an anglesmith shop and three building ways. Part of the outfitting of ships is done at this point. The plate superintendent's and electrician's offices are located here, as this is the most central part of the plant.

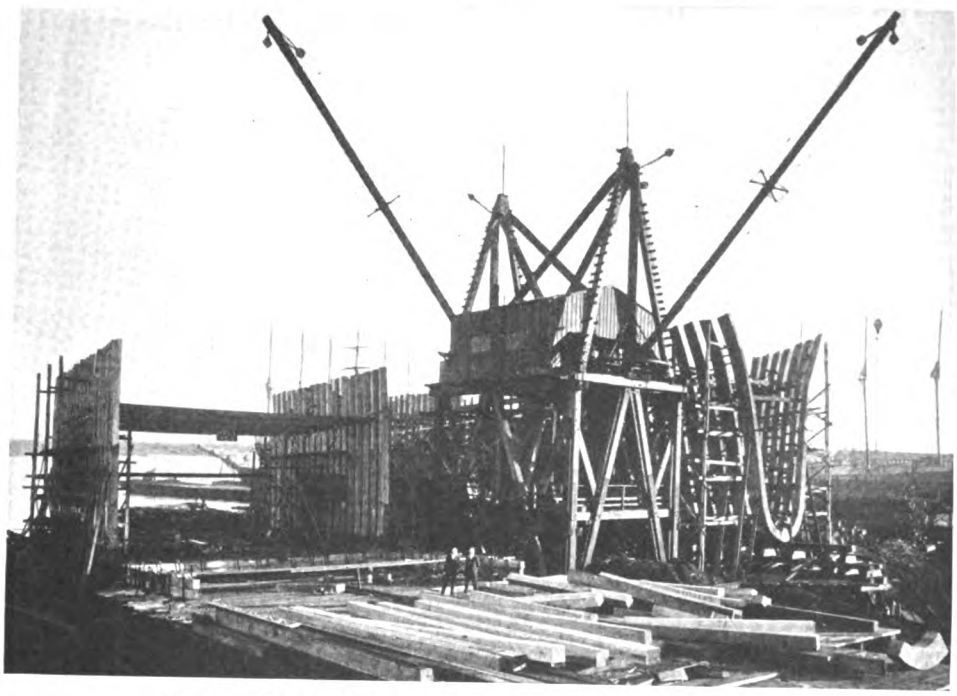

Fig. 4.—Wooden Hulls Under Construction at Gulf Department

The Gulf Department

At the extreme southern end is the Gulf department, which is an enlargement of the Gulf Dry Docks Company property. At this point wooden hulls are built and outfitted. There are also two Crandall marine railways, the larger having a capacity of fifteen hundred tons.

On Pinto Island, which one year ago was a sand dune, are now three dry docks, a machine shop and a 360-foot building berth, in addition to two smaller sets of building ways.

The machinery department is now equipped to make any kind of repairs and to build engines. Castings up to three tons in weight have been poured in the foundry, which has two seven-ton cupolas. This department has made most of the parts for three 1,400 indicated horsepower engines and installed them in the hulls built by this company. As far as the writer knows, this is the only company on the Gulf which has built marine engines.

Fig. 5.—Panama Barge, Hull No. 9

In the plate department have been built the hulls of three mine sweepers and also one steel barge of 7,500 tons deadweight for the Panama Canal Commission. This necessitated the handling of about twenty tons of structural steel a day through the plate shop. The steel for the Panama barge was ferried across the river to Pinto Island, where this vessel was built on a side-launching way.

In the Gulf department have been built two wooden steamers of 3,500 tons deadweight each. Most of the pontoons for the 10,000-ton floating dry dock were built here. On the Crandall marine railways numerous

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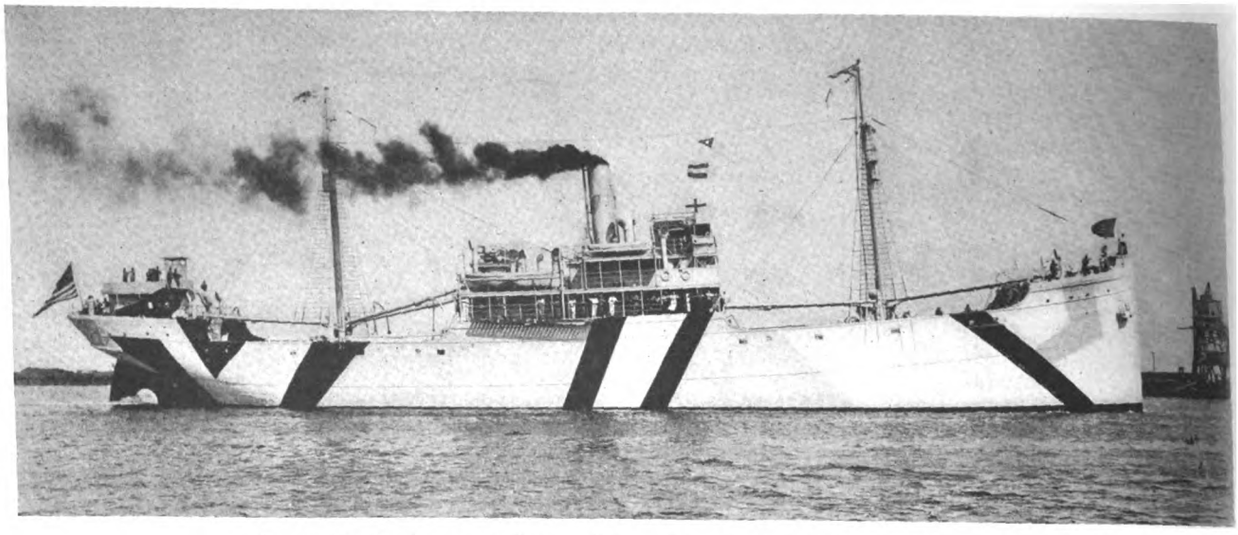

Fig. 6.—S. S. *Banago*, Built by Alabama Dry Dock & Shipbuilding Company

small vessels have been overhauled, painted and repaired.

Pinto Island has been the main department for dry docking and repairs. Ferry lines run to it from all other departments. On the north end of the island the first Panama barge is being built and another one is to be built here. Some pontoons were built in this department for the 10,000-ton dry dock. At the south end of the company's property on this island has been dredged a slip 895 feet long by 216 feet wide and 40 feet deep for the 10,000-ton dry dock. This dry dock is built in two sections, so that either one may be used independently for lifting 5,000 tons weight. Directly north of this is the 4,000-ton floating dry dock formerly owned by Ollinger & Bruce, and still farther north is a 1,000-ton sectional floating dry dock. A large mill, forge and woodworking shop have been erected, and also an air compressor. As the island is not connected with the city water supply, a 30,000-gallon tank has been put on an 85-foot tower for fire protection purposes.

During 1918, over 130,000 tons of ships were dry docked and about 750,000 tons of ships have been repaired. One of the most interesting pieces of work done here was the fitting out of the S. S. *Lucia* with air chambers to make her unsinkable. Details of the work were described by W. T. Donnelly, consulting engineer, New York, before the Society of Naval Architects and Marine Engineers at its last annual meeting.

There are two ways of handling material from one de-

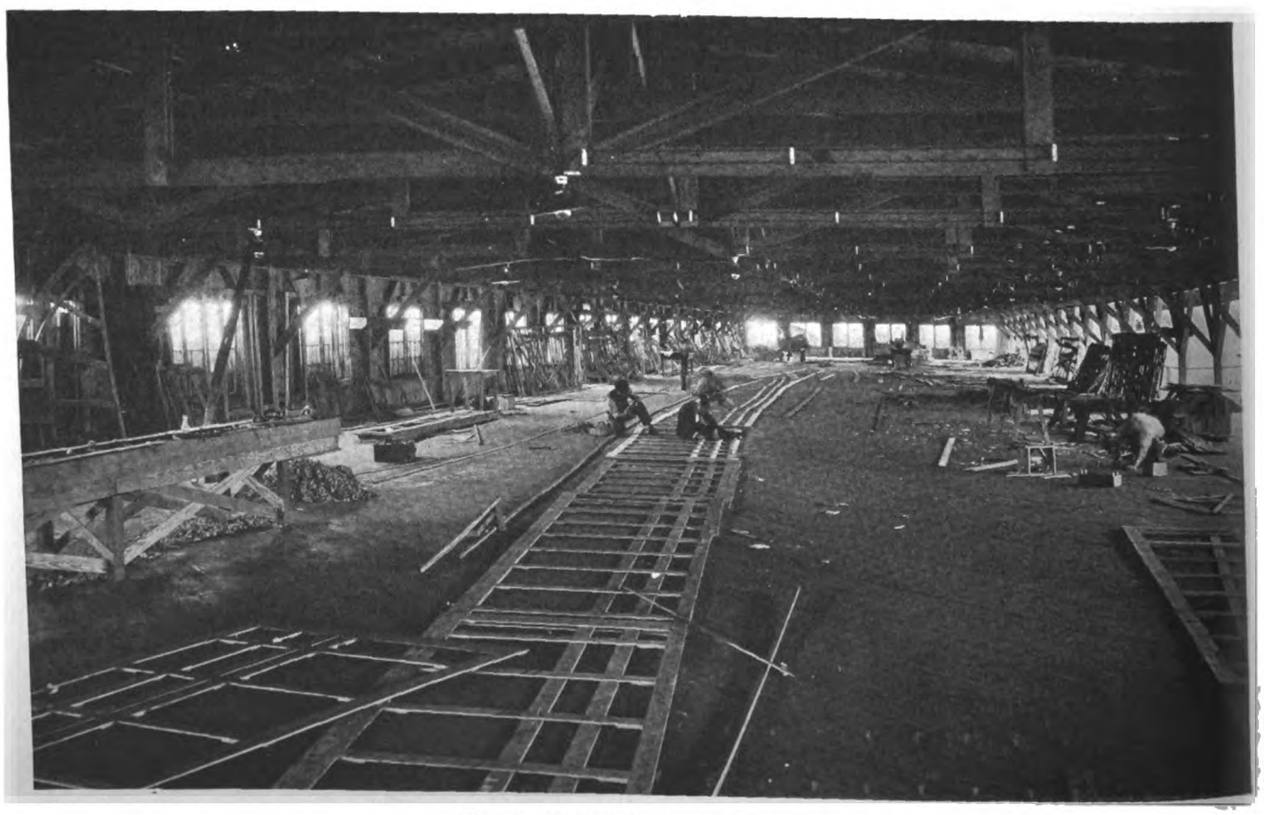

Fig. 7.—Mold Loft at Plate Department

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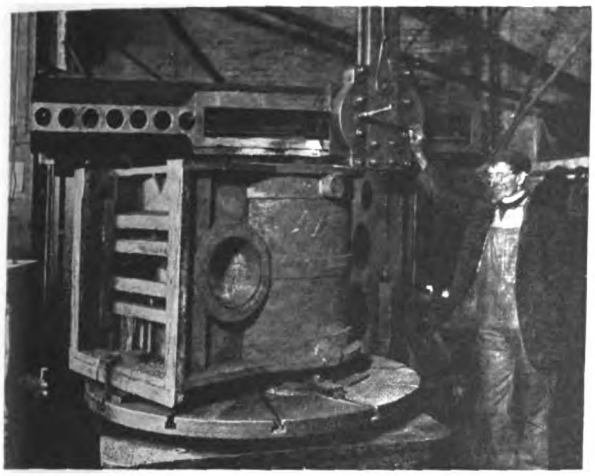

Fig. 8.—Machining an Engine Cylinder in the Machine Shop

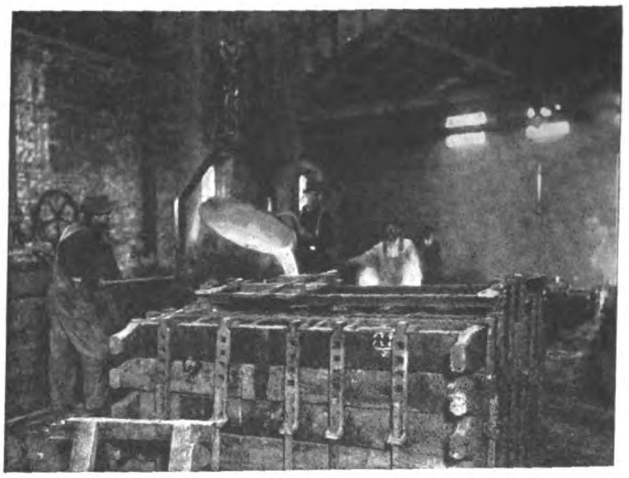

Fig. 10.—Pouring a Casting in the Foundry

partment to another on the mainland, namely, by railroad and by motor trucks. The company uses the Louisville & Nashville Railroad main line from the north end of the plant to the south, sidings running into each department. Parallel to this railroad are Water and Royal streets, along which motor truck service is maintained. Steel is carried in the yards, and from the plate department to the ferry and construction ways by electric trucks.

The wooden ships and the mine sweepers were served by stationary derricks, but the Panama barges are being built with the aid of a traveling tower whirler. At conspicuous places in the yard are placed boards with movable models of each ship attached to show the progress that is being maintained on the construction. This has been found to stimulate the interest of the different gangs of workmen building the various hulls, and has a good effect in creating competition among them.

Improvements in Ship Construction.—In a paper read before the Institution of Engineers and Shipbuilders in Scotland, E. F. Spanner, R. C. N. C., proposes a new method of providing a central pipe or duct in the lower portion of a vessel for the purpose of dealing with fluid distributed in different compartments along its length. In this particular development it is proposed to provide the central fore-and-aft duct by dispensing with the ordinary vertical keel plate and by working instead a relatively narrow box keel running the length of the vessel and having an uninterrupted passage through it from one end to the other. It is claimed for this duct-keel system that not only it is possible to eliminate practically the whole of the pipes forming the ordinary filling and suction systems, but also that practically the whole of the heating pipes can be dispensed with. In the case of a vessel burning coal and using the double-botton tanks primarily for the carrying of water ballast, the provision of the duct keel enables virtually the whole of the ballast suction system to be dispensed with, while no holes are necessary through watertight bulkheads. Further, water entering the ship following damage cannot find its way along the ship to other undamaged compartments by way of the keel duct except under the control of the ship's officers through the system of valves which is installed.

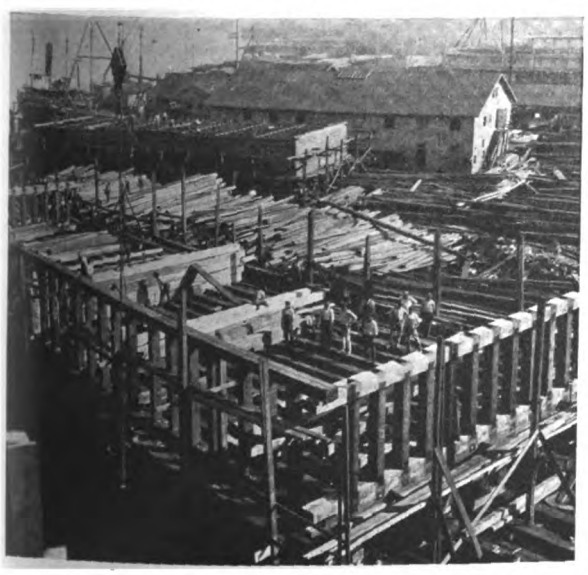

Fig. 9.—10,000-Ton Dry Dock Pontoons Nos. 3, 4 and 5

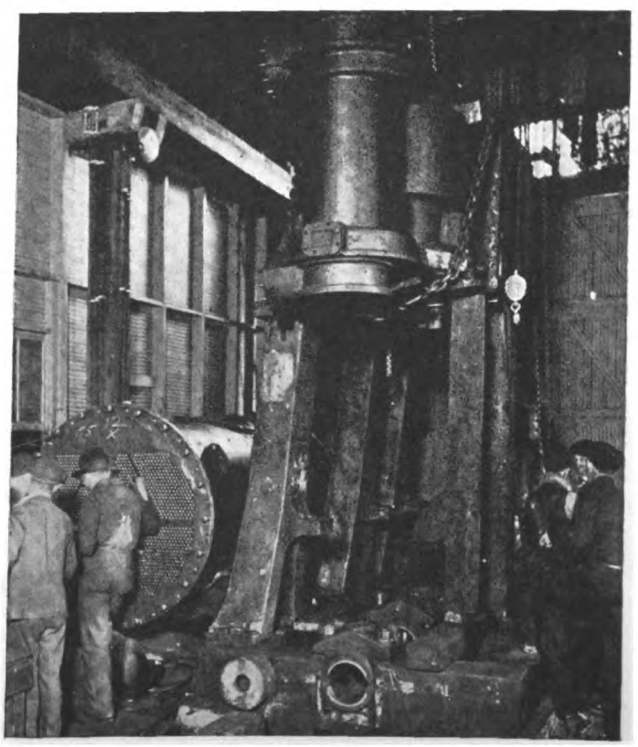

Fig. 11.—Lining Up an Engine in the Machine Shop

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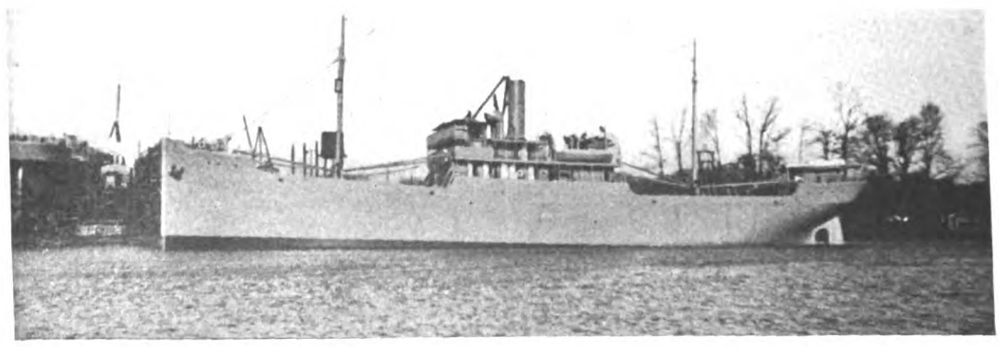

Fig. 1.—S. S. *Daram;* Hull 181; Fifth Ship Built at the Traylor Shipyard

Large Wooden Shipyard on the Delaware

Traylor Shipbuilding Corporation Organized to Build Wooden Ships for the Emergency Fleet—New Yard Erected at Cornwells, Pa.

BY R. R. SHAFTER*

IN April, 1917, the Traylor Engineering & Manufacturing Company, Allentown, Pa., secured a contract from the United States Shipping Board for ten 3,500-ton, "Ferris" design, wood cargo-carrying steamships, complete, including the installation of all propelling machinery, deck machinery, etc. At that time this was the only contract placed for a complete wooden ship with an Eastern concern.

Negotiations for the purchase of the plant and property of the Enterprise Manufacturing Company at Cornwells, Bucks County, Pa., on the Delaware River, sixteen miles north of Philadelphia, were consummated, and the Traylor Engineering & Manufacturing Company, in the month of April, 1917, took over the property and organized the Traylor Shipbuilding Corporation, to which concern this contract was assigned. This property consists of approximately ninety acres of ground from the river to the main line of the Pennsylvania Railroad, a distance of approximately 3,250 feet, with a river frontage of approximately 1,200 feet. A State highway from Philadelphia to Trenton, parallel to the river, runs through the property to the north of the main shop buildings and about 1,200 feet from the river.

On the property were three concrete buildings—one a mill building 105 feet wide by approximately 700 feet long, a power house 40 feet wide by approximately 110 feet long, and another building, which was later turned into a mold loft, approximately 60 feet wide by 210 feet long, together with an anthracite gas producer building and a partly covered crane runway about 1,100 feet long. In addition to all this, there is a canal about 55 feet wide running

* General superintendent, Traylor Shipbuilding Corporation.

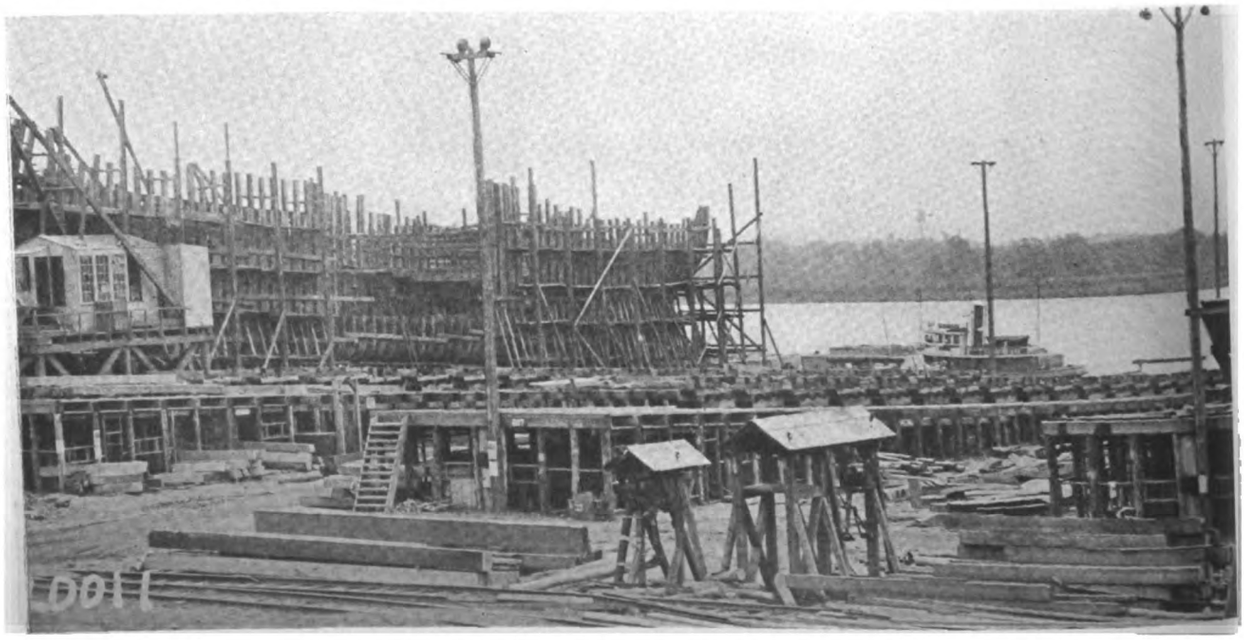

Fig. 2.—Partial View of Shipways, Showing Vessels in Frame

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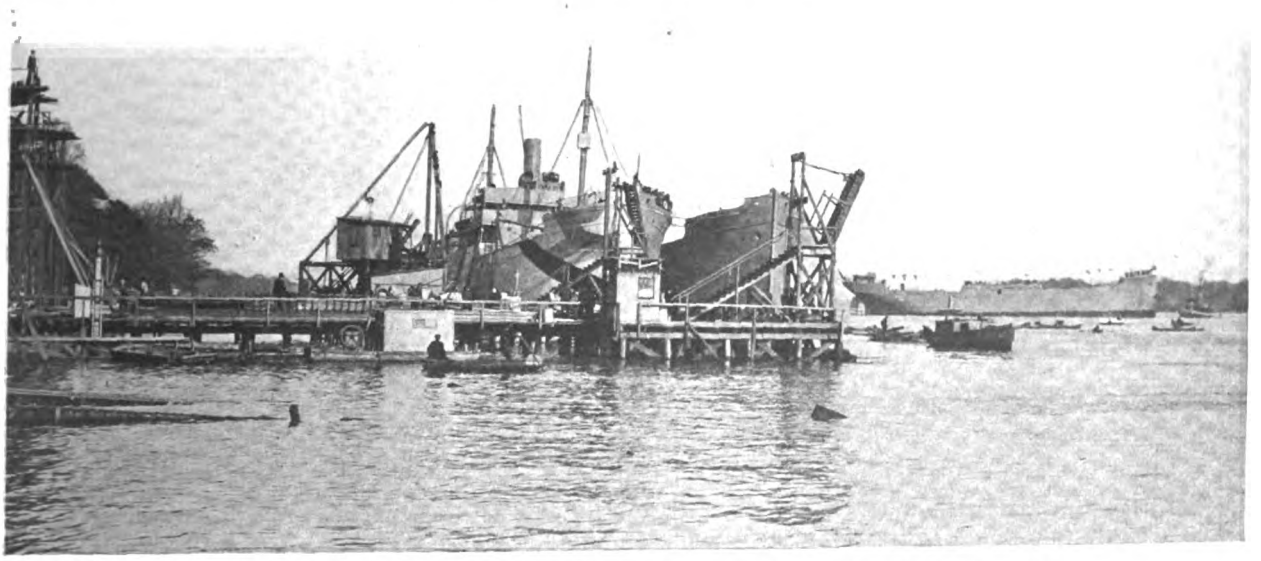

Fig. 3.—One Ship Ready for Sea Trial; Another Being Fitted Out, and Another Just Launched

from the river to the State road to the east of the property, a length of approximately 1,000 feet, and about one mile of railroad sidings and tracks.

Preliminary Construction Work

About the middle of May, 1917, actual work was started of cleaning out the old machinery in the large mill building. Overhauling of the power plant equipment was started at the same time, and the cleaning of the river front was started for the construction of the shipways and tracks.

While this preliminary work was going on, an organization was being formed known as the "Traylor Shipbuilding Corporation," and plans were being made of turning this property into a shipyard for the building of the wooden ships, with a view of speedy completion with the least possible expense. Up to about the middle of June, 1917, we had no interference of any kind from any Government men, but about that time a resident inspector for the Shipping Board was placed at the plant, from whom the Traylor Shipbuilding Corporation was to get authorization for the expenditure of money, as the Shipping Board, according to contract, was to pay for all plant improvement and equipment installed on the property.

The original plans showed ten shipways, and material was ordered for the ten ways, but after five were completed work was shut down on the other five, which were practically completed with the exception of that part of the ways out in the river under high tide. As for these five ways, it was found that piles could not be driven out in the river on account of a ledge of rock. Admiral Bowles, who was assistant general manager of the Emergency Fleet Corporation at that time, refused to allow the

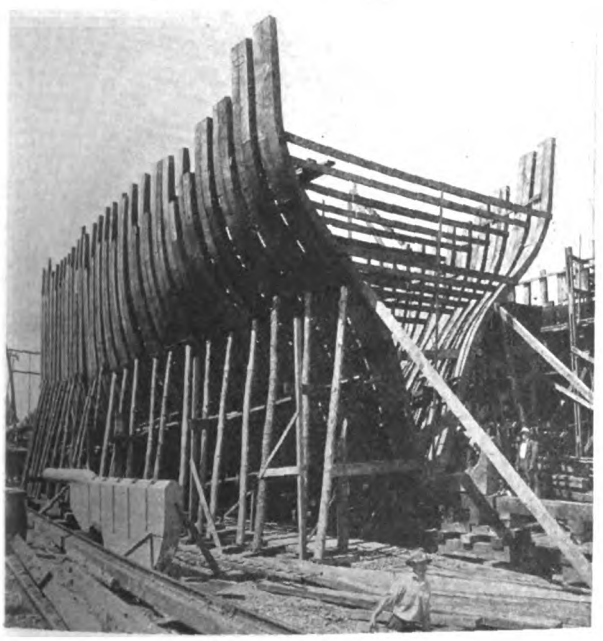

Fig. 4.—Erection of Frames

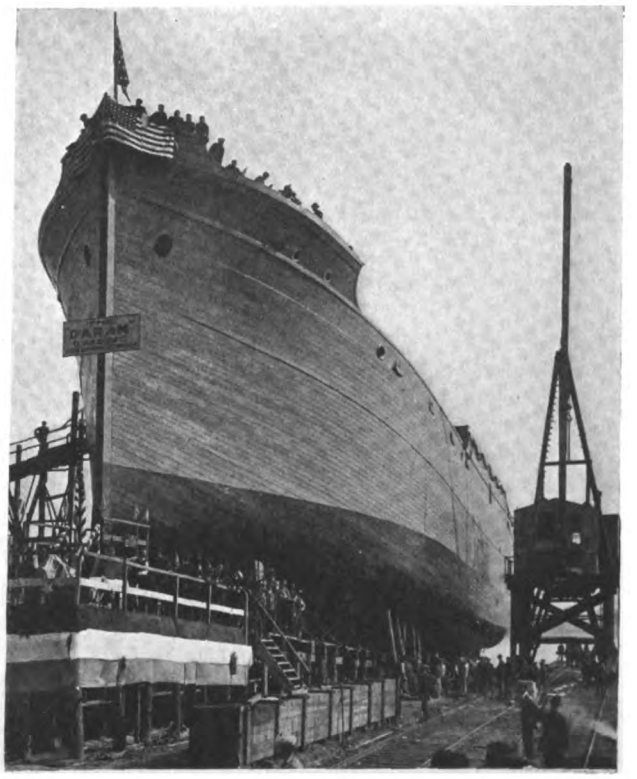

Fig. 5.—Hull Ready for Launching

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finishing of the last five ways, as he felt that a sufficient quantity of lumber, as well as a sufficient number of shipbuilders could not be secured for working ten shipways at one time.

Laying the First Keel

Practically a whole year was required to finish and complete the entire shipyard with all improvements, but just as soon as a shipway was ready for the laying of a keel the keel was laid. Consequently, the keel for the first boat, known as Hull 177 (S. S. *Alvada*), was laid on September 27, 1917; the keel for the second boat, Hull 178 (S. S. *Alapaha*), was laid on November 13, 1917; the keel for the third boat, Hull 179 (S. S. *Buhisan*), was laid on December 20, 1917; the keel for the fourth boat, Hull 180 (S. S. *Bulana*), was laid on December 24, 1917, and the keel for the fifth boat, Hull 181, (S. S. *Daram*), was laid on

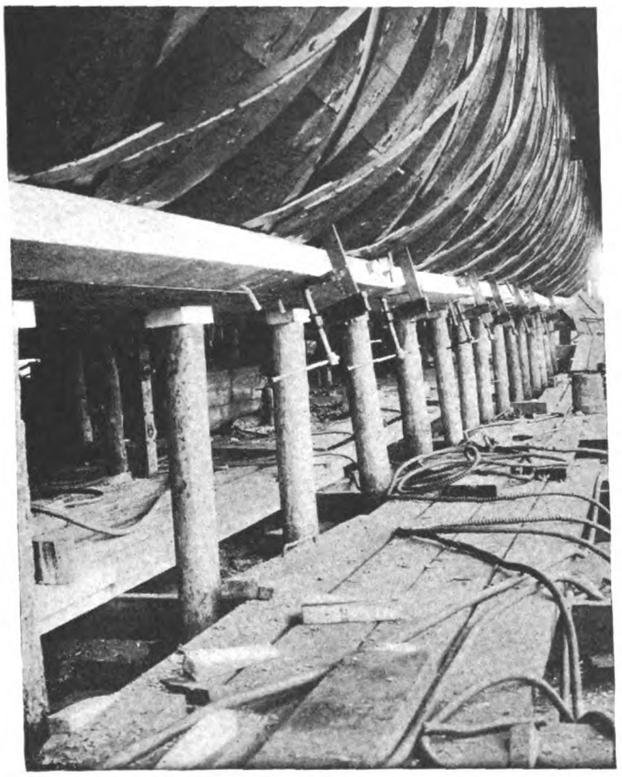

Fig. 6.—Bilge Construction, Showing Method of Planking. Note Steel Straps Across Frames

December 26, 1917. Thus the five shipways which we were permitted to use had keels on them before the first of the year 1918. Keels could have been laid earlier, as the shipways were ready before the actual time of keel laying, but the delivery of the lumber by the Shipping Board was very slow. It may be mentioned that at that time the United States Shipping Board undertook to supply all materials entering into the construction of these ships.

Work on the first boat went along very slowly, but with caution, as detailed drawings for the construction of these ships were not supplied at that time by the Shipping Board, with the exception of a general drawing and profile, and it was up to the naval architect and staff of the Traylor Shipbuilding Corporation to make all details and develop them on the mold loft floor, from which molds were made for the various timbers. Considerable delay and annoyance were caused by the continuous changes in design made by the American Bureau of Shipping and the Shipping Board.

Building Schedule

The first frame on the first ship was hoisted in position and fastened to the keel in October, 1917, by one of the traveling wooden gantry cranes which the company built for the handling of all material to the ships while under construction on the ways. The large floor timbers for frames for the ships, which are 12 inches by 26 inches by 30 feet long, did not arrive at the yard until the middle of February, 1918, so little work could be done on the ships for which keels were laid, except as regards the stem and stern construction and fore and aft cant frames. As an instance of this delay, the keel for the first ship was laid in September, 1917, but actual work in volume could not be done on the ship until the middle of February, 1918, when heavy floor timbers arrived. After that date progress was shown, and during the months of April and May such speed and progress were developed that on June 1 Hull 177, the *Alvada*, was launched. From then on boats were launched in rapid succession, and up to this writing (January 31, 1919) the following is the schedule of launchings and deliveries of completed ships to the Shipping Board:

Hull No.	Name of Ship	Launching Date	Delivery Date
177	*Alvada*	June 1, 1918	August 20, 1918
178	*Alapaha*	July 4, 1918	September 21, 1918
179	*Buhisan*	August 17, 1918	October 28, 1918
180	*Bulana*	September 2, 1918	November 21, 1918
181	*Daram*	October 19, 1918	December 19, 1918
182	*Tanka*	December 18, 1918	January, 1919

This leaves four ships still to be launched and four ships to be fitted up. The possible launching and delivery dates of the balance of the vessels are as follows:

Hull No.	Name of Ship	Launching Date	Delivery Date
183	*Oraton*	February 5, 1919	March 10, 1919
184	*Seypen*	February 25, 1919	March 25, 1919
185	*Albriton*	March 20, 1919	April 20, 1919
186	*Allerton*	April 15, 1919	May 15, 1919

During the spring of 1918 a wooden wharf or fitting-out dock was built at the head of the canal, where the ships are moored for fitting up.

Considerable time elapsed between the launching of the first hull on June 1 and delivery of this ship on August 30 on account of the non-arrival of machinery and equipment supplied by the Shipping Board. The same held true with the second ship, launched on July 4 and delivered on September 21, as well as the third ship, launched on August 17 and delivered on October 28; but after that date material arrived in better shape, and it was possible to catch up with launching dates, so that a ship was launched and a ship was delivered every month, each ship being delivered a month after it was launched.

Gantry Cranes

The gantry cranes, one between each shipway, are of the traveling type, with a stiff leg mounted on a high platform, operated by a steam engine. These gantry cranes have given wonderful service, and the cost of upkeep has been very small indeed for the class of work they performed. They are of five-ton capacity and can reach any part of the ship with a load. This design of gantry crane was copied by many shipyards throughout the country.

Between the long mill building and the shipways, a distance of about 250 feet, is the woodworking machinery, which prepares the rough timber into a finished state for delivery to the ships. The timbers are handled by locomo-

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tive cranes on tracks up to the head of the ways, where they are delivered to the gantry cranes running between each shipway. In the large mill building are located the joiner shop, the storeroom for the small ships' material and equipment, the small machine shop, coppersmith shop, pipe shop, blacksmith shop and tool room, as well as the miscellaneous shops, such as the saw hospital, electrical shop, belt shop and millwrights' benches. At the southwest end of the mill building is the main office.

Power Plant

The power plant consists of anthracite gas producers, which generate gas for operating two gas engines, each directly connected to a 175-kilowatt generator, and a 150-horsepower gas engine driving by a belt a 1,600-cubic foot cross compound Ingersoll-Rand compressor. Half of the plant machinery is driven by direct current generated at the plant, while the other half is driven by alternating current purchased from the East Penn Gas & Electric Company, of Bristol, Pa., stepped down from 13,000 to 2,400 volts at a transformer sub-station on the shipyard property and again stepped down to 440 volts by transformers located in the power house. This was done so that the possibility of the whole plant being shut down on account of lack of power would be eliminated.

The delay in securing ship material during the winter of 1917-18, due to the very severe winter and the congestion of the railroads, held the Traylor Shipbuilding Corporation back four months, and during that period there were only about 500 men employed at the plant; but after February, 1918, when ship lumber and material arrived in big quantities the payroll increased and reached its high peak in July, 1918, when there were about 3,500 men on the day shift and about 800 men on the night shift. During the summer months two shifts were operating continually.

Labor Conditions

On account of the fact that the wood shipbuilding industry had become practically "a lost art," it was impossible to secure experienced wood shipbuilders; consequently, the Traylor company resorted to the employment of ordinary house carpenters and laborers and instructed them in wood shipbuilding, so that it was not very long until the company had an efficient organization and working force. In October, 1918, when the Spanish influenza epidemic spread through the country, many of the men were sick, while others left for indoor employment, so that in November of that year only about 2,200 men were on the company's payroll. Shortly after the signing of the armistice the approach of winter and the continued published reports of the Shipping Board to the effect that the wood shipbuilding programme would be discontinued caused a further reduction in the working forces, so that in January, 1919, there were only 1,600 men on the payroll, just enough to carry the schedule of the delivery of ships through.

Effective Labor-Saving Devices

Many labor-saving devices were used in the Traylor yard—some designed and built by the Traylor organization and others purchased from machinery builders—so that whereas in the old days it took ten to fifteen months to build the hull of a wooden ship of about 3,500 tons capacity, it required an average of only five months for this work at the Traylor yard. The Traylor Shipbuilding Corporation has the distinction and honor of having turned out up to this writing (January 31) the largest number of completed ships of any of the shipyards on the Atlantic and Gulf coasts operating under United States Shipping Board contracts. A total of six ships was delivered up to January 31, 1919. As a comparison, the Hog Island yard, with fifty ways, to this writing has delivered only three ships; the Merchant yard, at Bristol, with twelve ways, one ship, and the Submarine Boat Corporation, at Newark, with twenty-eight ways, one ship.

The completed ships turned over to the Division of Operations of the Shipping Board in every instance made

Fig. 7.—Fastening Lower Shelf Timbers

highly satisfactory and successful dock trials at the shipyard at Cornwells and sea trials down the Delaware River past the Capes. In every case the ships were accepted by the United States Shipping Board, the American Bureau of Shipping and the United States Steamboat Inspection Service immediately after sea trial, without requiring any of the ships to go back to the yard for any repairs. This is a record of which the yard may well be proud.

The Crippled Soldier and Sailor, and How Their Disabilities May Be Discounted

BY DOUGLAS C. MC MURTRIE*

IN the past, our method of dealing with men permanently disabled in the course of employment has been to pay the worker a pension in the form of compensation, and forget him and his injury. But the cost of disability in the shipping industry has not been alone in the premiums paid for casualty insurance. There has been the cost involved in the training, experience and adaptation of a skilled worker who does not return to his job, and the fitting of a newcomer to take his place.

There are three means of reducing and approaching the complete elimination of the cost of disability: first, accident prevention; second, thorough medical attention to minimize the disability resulting from the injury, and third, salvage of the remaining abilities of the worker through rehabilitation for self-support. The first of these has already received wide attention from employers and has wisely been encouraged in a financial way by casualty insurance companies and state funds. The values of the two latter have, however, not as yet been appreciated.

* Director, Red Cross Institute for Crippled and Disabled Men, Twenty-third street and Fourth avenue, New York City.

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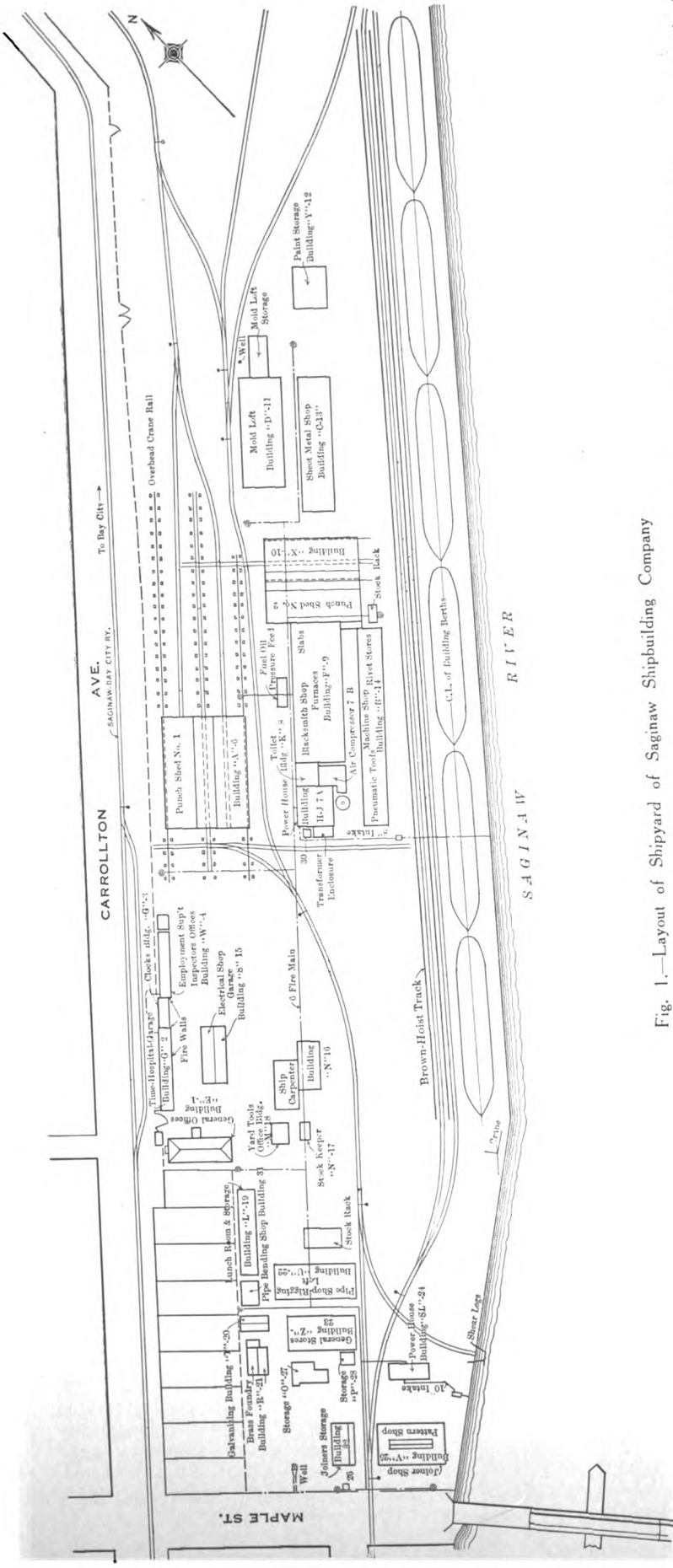

Fig. 1.—Layout of Shipyard of Saginaw Shipbuilding Company

Their enegetic application would effect a tremendous saving to industry.

Unlimited Medical Attention of the Highest Grade Should be an Axiom of Casualty Practice

Many injuries from which men would completely recover in a short time under adequate and high-grade medical attention are treated for an insufficient time, or by incompetent physicians and, instead of a prompt return to work, the case at best drags along over an extended period and at worst becomes chronic or develops into permanent disability. Some States require the insurance carrier to provide but two weeks of compulsory free medical attention to the injured man. For the insurance company to take advantage of this limitation is the most short-sighted policy possible, because for every dollar saved in physicians' or hospital fees, the insurance carrier pays out later ten dollars in compensation. And what the insurance company pays is actually paid by the insuring employers in their regular premiums.

Unlimited medical attention of the highest grade should be an axiom of casualty practice. It should be insisted upon by employer and workman alike. The best outcome of any injury is to have the employee return to his job as a well man in the shortest possible time. It is well to develop a science of dealing with cripples, but the ideal is to have fewer and fewer cripples with which to deal.

Rehabilitation for Self-Support

The third method of attack on the cost of disability is rehabilitation for self-support—the re-education of an injured man for an occupation which he can follow, or a process which he can perform, in spite of his handicap. The science of rehabilitation is new, and the experience in it has practically all been gained in the effort to make sound and just provision for the disabled soldier or sailor. Every country among the recent belligerents is to-day operating a comprehensive system of re-education for disabled soldiers, and is placing upon that system more dependence than upon the pension system.

Paying a man a small monthly or weekly stipend on which he is expected to live in idleness is not a very constructive method. With the breakdown of confidence in the pension system, it was realized that the only real compensation for disablement was restoration of capacity for self-support. It was further realized that very few jobs require all the physical faculties, and that in the present-day variety of industrial processes it is possible to find a job in which a man with a given type of disability can function 100 percent efficient.

Special School for Crippled Men

The process of retraining the disabled is known as re-education, and can best be

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provided in a special school for crippled men. The first school of this kind in the United States is the Red Cross Institute for Crippled and Disabled Men, established in New York City through the generosity of Jeremiah Milbank. At this school, open to disabled civilians and soldiers alike, six trades are already being taught: artificial limb making, motion picture operating, oxy-acetylene welding, printing, jewelry work, and mechanical drafting. More will be added as the demand develops. Graduates are already giving satisfaction in the jobs to which they have been graduated, so the enterprise has passed the experimental stage. And in the results attained with disabled soldiers abroad, there is overwhelming evidence of the logic and practicability of rehabilitation.

The cost of soldier rehabilitation is being met by the United States Government and by the governments of some of our allies. It will be admitted without argument as desirable that the advantages of re-education be made available to disabled civilians as well, but will not the cost be prohibitive? The fact is that rehabilitation effects a reduction, rather than an increase, in the cost of disability, to industry or to the community as a whole.

In short, the first effort should be to prevent injury; the second, to minimize its permanent effects; the third—when disability has ensued—to offset its economic consequences. The execution of this complete program is not only sound humanitarian practice—it is good business as well.

Saginaw Shipbuilding Company

CONSTRUCTION of the new shipyard of the Saginaw Shipbuilding Company, Saginaw, Mich., was begun in the fall of 1917 and completed in the fall of 1918. Ship construction was begun in January, 1918, and was carried along simultaneously with the building of the plant.

Of the twenty-four ships under contract, twelve are of 3,500 deadweight tons and twelve are of 4,050 deadweight tons, all-steel cargo-carrying steamers of the ocean-going type. Six of these ships have been delivered to their owner, the United States Shipping Board Emergency Fleet Corporation. The second six are well along and rapidly nearing completion. A very large amount of material and equipment is on hand for the last twelve ships, and the work of fabricating this material and considerable construction work for these ships is well advanced.

The yard covers approximately forty acres of ground, with a shop floor space of over 160,000 square feet. There are six large building berths equipped to construct any size or type of ship that may be desired. In December, 1918, a total of 1,762 employees were at work in the yard. Owing to the close proximity of the plant to Saginaw and Bay City, Mich., the housing conditions for employees are excellent. Transportation is well taken care of, both by steam and electric lines.

The building berths extend along the waterfront for a distance of 1,700 feet, and there is still available on the present property holdings of the company a space of 700 feet for additional berths. Owing to the fact that one building berth is a continuation of another, a series of vessels of any desired length, whose total does not exceed 1,700 feet, can at the present time be constructed.

Two large fabricating shops, one of 19,900 and the other of 17,100 square feet area, have been erected. The plant is thoroughly equipped with all modern machinery and equipment necessary for the rapid construction of steel ships. Every convenience for the care, welfare and convenience of employees, such as a hospital with doctor and competent attendants, restaurant, toilets, wash-rooms, etc., has been installed.

The equipment for handling material consists of four 5-ton overhead electric traveling cranes, four 20-ton steam locomotive cranes, two 15-ton electric portal pier Brown hoists, and one switching locomotive.

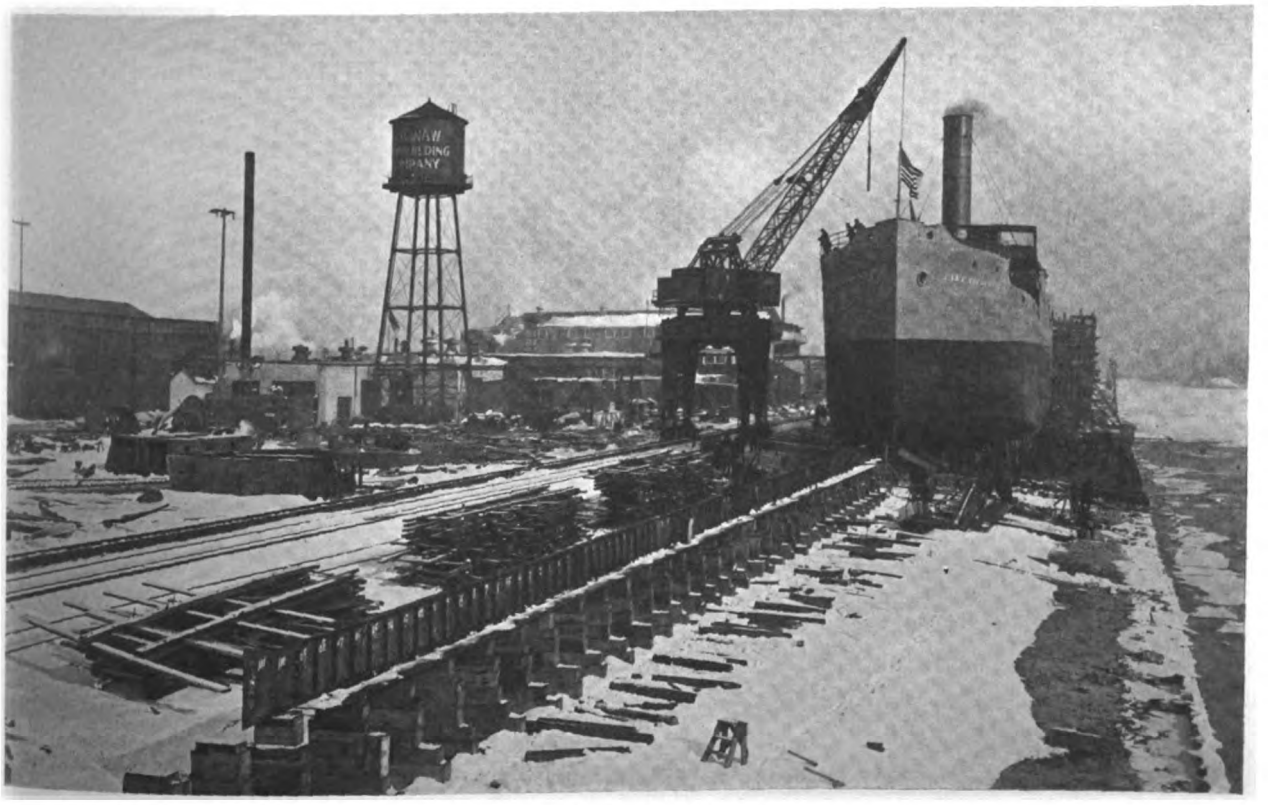

Fig. 2.—Building Berths at the Saginaw Shipyard

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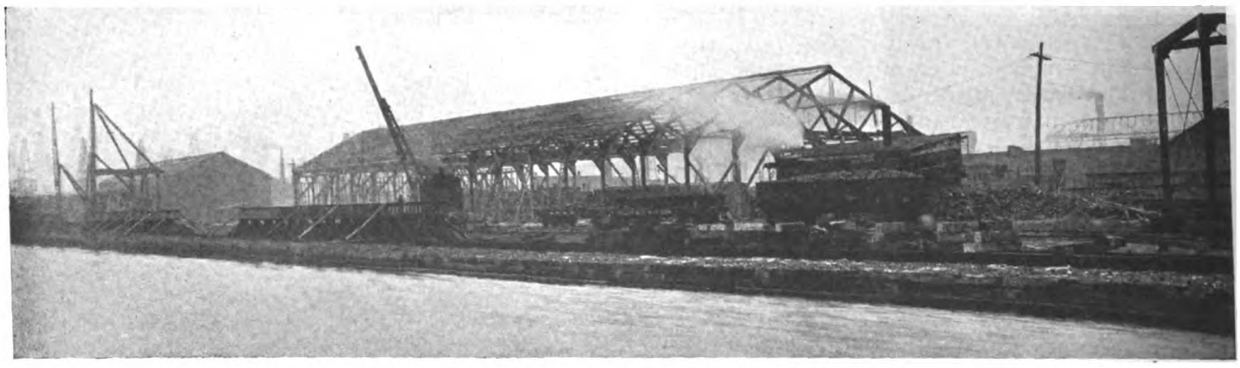

Fig. 1.—General View of Fabricated Ship Corporation Yard

New Shipbuilding Enterprise in Milwaukee

Fabricated Ship Corporation Builds Yard for Construction of Steel and Concrete Vessels—Government Ships Under Construction

BY ARTHUR F. JOHNSON, M. E.*

THE Fabricated Ship Corporation, Milwaukee, Wis., was founded by the Newton and Coddington Engineering Companies, both of that city. The yard is equipped and laid out to build all types of steel or reinforced concrete vessels. It occupies about thirteen acres at the foot of Twelfth street and is waterbound on three sides. The property is long and narrow, facilitating a compact and efficient arrangement for sidewise launching.

Work on the yard was begun during the latter part of August, 1918. It was necessary to lower the grade three

* Production engineer and naval architect for the Fabricated Ship Corporation, Milwaukee, Wis.

Fig. 2.—Interior of Fabricating Shop

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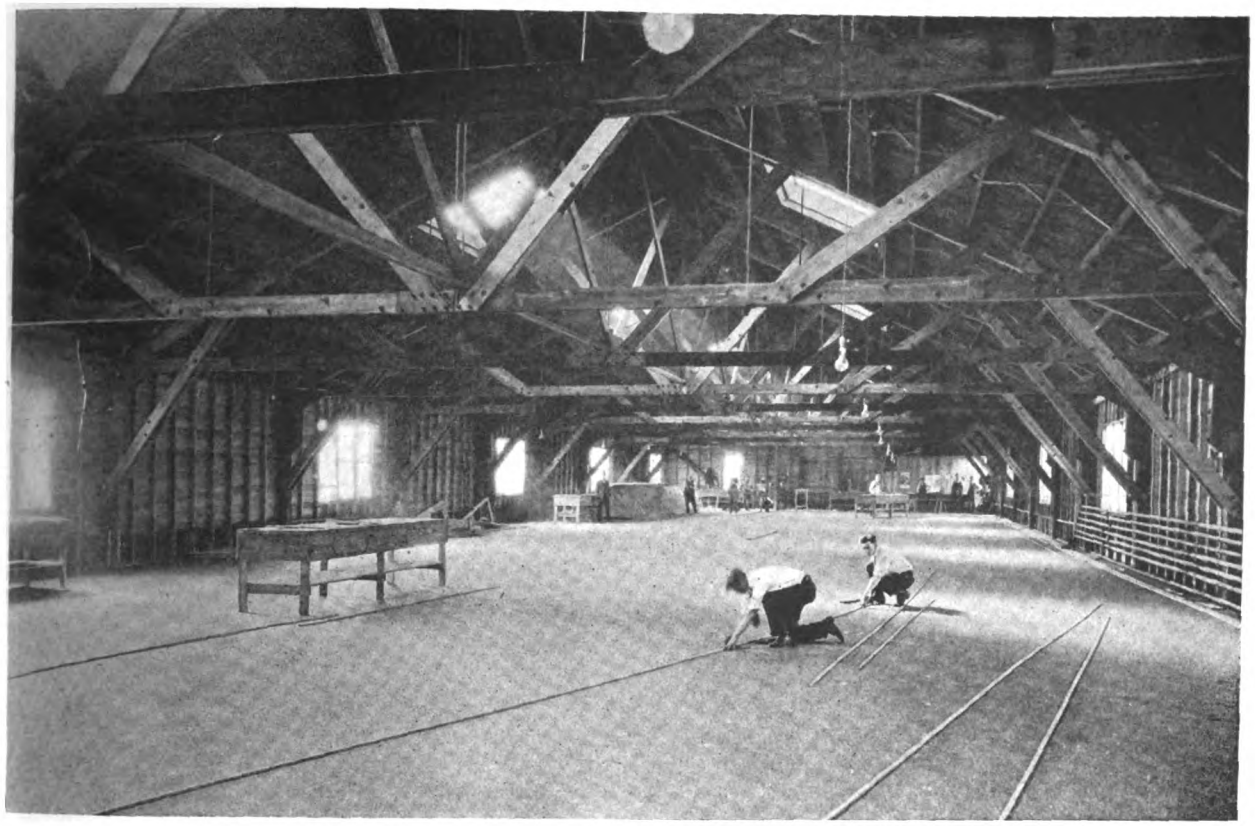

Fig. 3.—Mold Loft

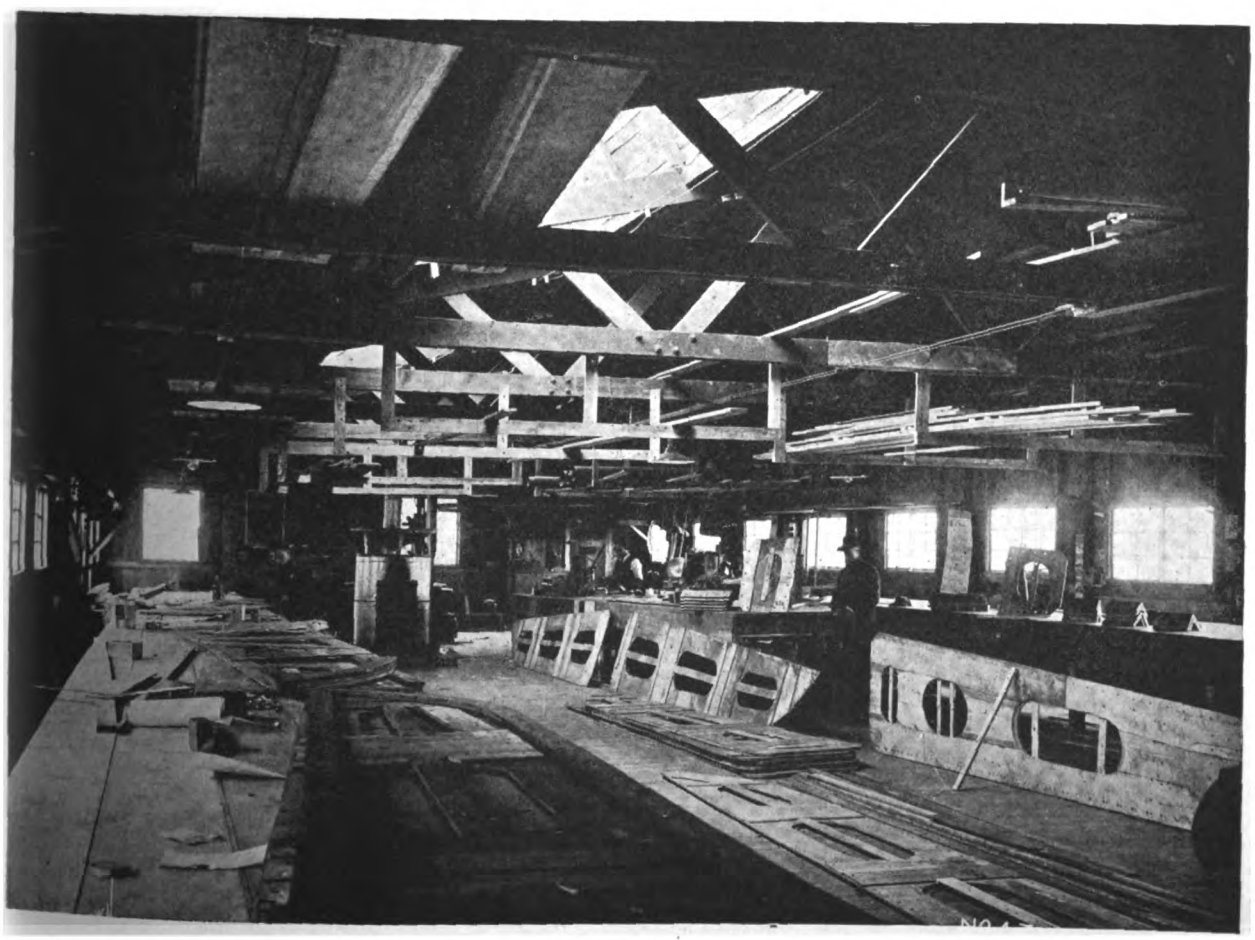

Fig. 4.—Pattern Shop

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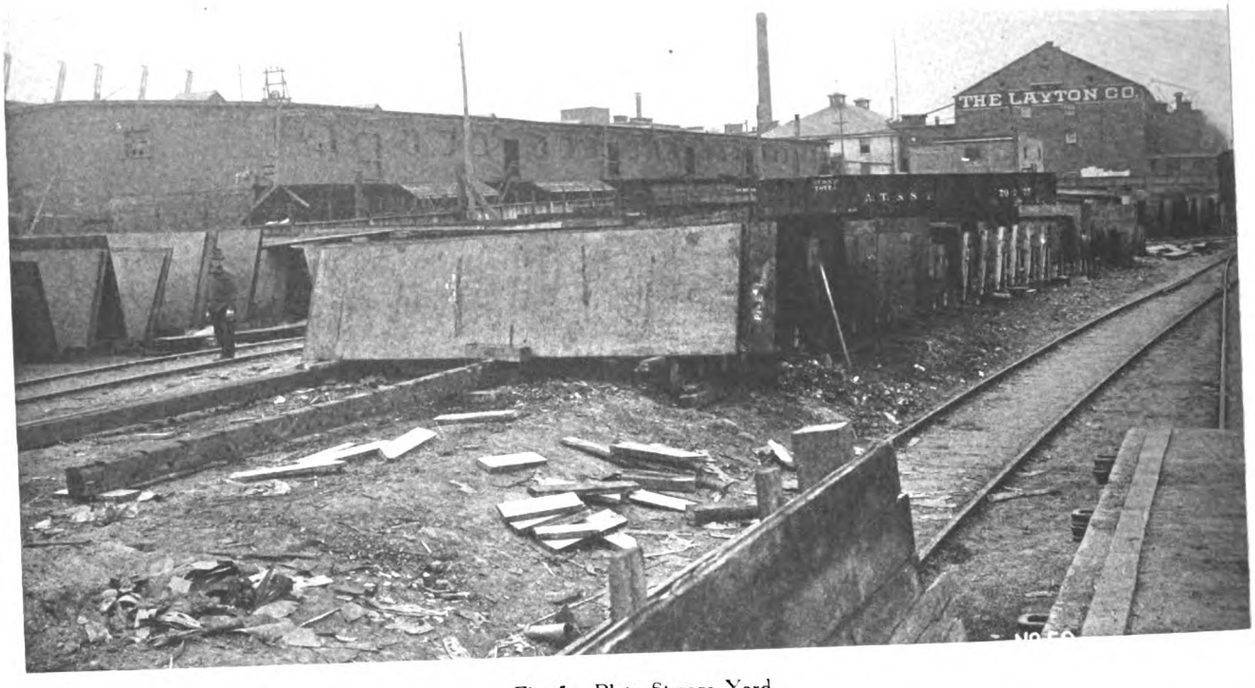

Fig. 5.—Plate Storage Yard

feet at the building berths, drive piles under the keels, repair and straighten the dock face, build new switches and railway tracks, erect buildings, install a power plant and yard machinery, build shipways, erect gantries and perform numerous other items incidental to the layout of a new yard.

Vessels Building for the War Department

The company is building nine twin-screw steel mine planters and four twin-screw steel river steamers for the Water Transport Branch, Embarkation Service, War Department. The design and early stages of construction for these ships were carried on simultaneously with the yard layout, as some of the pictures clearly show.

The administration building was on the property when taken over, so that with interior alterations it was soon ready for occupancy. The hull drawing office is located in the upper story of the administration building, and the engine drawing room is in a wing recently added. The mold loft was erected first and templates were shipped to the Lakeside Bridge & Steel Company, North Milwaukee, Wis. Here structural members were prepared for erection, a maximum amount of shop rivets being driven. Fabricated steel was erected in the yard before much of the final equipment was at hand, but the steel construction had just progressed to the desired stage when the plant was in condition to receive and handle what had been planned.

Arrangement of the Yard

The general arrangement, Fig. 1, indicates the possibilities for compact and efficient layout with sidewise launching. All material arrives at the land end and passes through successive stages in preparation to the finished product without doubling back in the processes. The raw material is stored at the entrance end, passing through the plate and angle shop to the storage for members ready for erection. From here it can be distributed to the building berths on each side of the "material zone." The warehouse, pipe shop, machine shop, power house and mold loft are at the far end of this zone.

Berths 1 to 7 are on the north side of the property on the Kneelands Canal. Berths 8 and 9, with the fitting-out dock, are on the south or Menomonee River side.

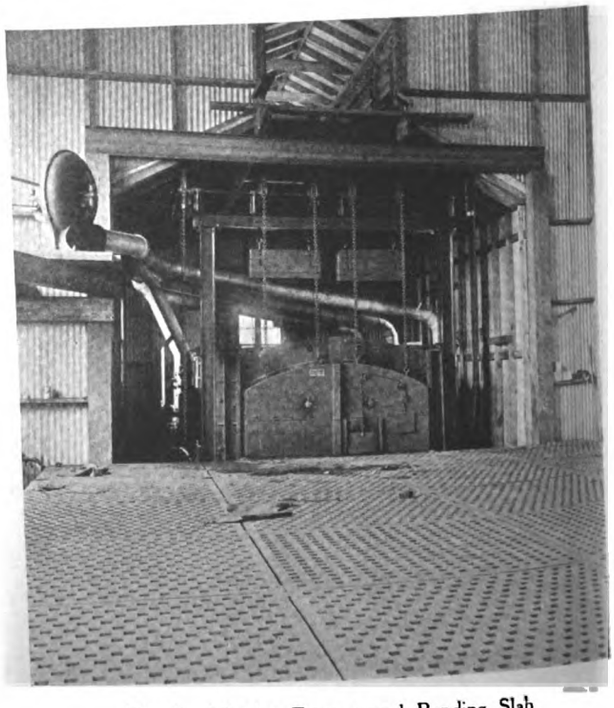

Fig. 6.—Heating Furnace and Bending Slab

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Shops and Equipment

The plate and angle shop equipment consists of a large oil-burning furnace, bending slabs, blacksmith shop, plate shears, angle shears, planers, punches, etc. Material is handled by overhead trolleys, jib cranes, or by the standard gage railroad tracks through the center of the shop.

The hull superintendent's office is at the east end of the plate and angle shop, facilitating his constant observation of all steel production and erection.

Methods of Handling Materials

Hull material is handled by 15-ton electrically driven whirling gantries, one to each building berth. They outreach beyond the far side of the vessel and are raised on a triangular frame to a level well above the upper deck. On berths 1 to 5 the gantries are between the railroad tracks and building berths. The gantries at berths 6 and 7 are bridged over the main tracks. By this arrangement material can be unloaded from cars direct to the ships or to the space alongside of ships for temporary storage.

Fifteen-ton locomotive cranes handle material in the raw and finished storage spaces. They also serve for switching cars and handling miscellaneous material in the yard. Fixed derricks in the storage yards also handle material.

The machine shop, pipe shop, tool room, warehouse and offices of the machinery superintendent and master mechanics are on the lower floor of the large building between berths 6 and 7, and the power house at the eastern end of the property. The second story of this building is occupied by the mold loft.

Power Plant

The power plant furnishes electric and pneumatic power for all equipment and tools in the yard, as well as steam for heating and other purposes. Three large cylindrical return tubular boilers generate steam for the compressors and generators.

A 25-ton derrick is used at the fitting-out dock for installation of heavy weights, engines, boilers, etc.

Work is in view for commercial vessels of steel and reinforced concrete, and the yard has prospects of a lasting activity. Its location is favorable from the standpoints of labor and material markets, and Milwaukee is enthusiastically behind the project.

Repairs to Boilers by Welding.—The repairing of the boilers of passenger steamers by electric or oxy-acetylene welding has been tentatively in operation for a considerable period, and, in view of the experience gained, the surveyors of the British Board of Trade are directed that, provided the work is carried out to their satisfaction by experienced workmen, these processes may be employed within limits for repairing cracks in furnaces, combustion chambers and end plates of boilers and, in the same parts, for reinforcing the landing edges of leaky riveted seams which have become reduced by repeated chipping and calking. For the present it is not proposed to prohibit within limits the reinforcing of the circumferential seams of boiler shells, if the end plates are well stayed, but no welding should be done to these parts by any processes which might cause local heating over an appreciable area of the plate. In no circumstances should any part of a boiler of a passenger vessel be welded, if wholly in tension under working conditions, such as a stay or a shell plate at a longitudinal seam, the failure of which by cracking at the welded part might lead to disastrous results.

Wrecking Steamer Favorite Nearing Completion on the Great Lakes

THE new wrecking steamer *Favorite,* building at the yard of the Great Lakes Towing Company, Cleveland, Ohio, to replace the wrecker of that name which was taken over by the United States Navy late in 1917, is about completed and will be ready for business at the opening of navigation on the Lakes. The *Favorite,* which is said to be one of the most complete salvage ships afloat, will be stationed at St. Ignace. Captain Alex Cunning, wrecking master for the Great Lakes Towing Company, will bring the new boat out, and James Callahan, who was chief engineer of the old *Favorite,* will have charge of her machinery.

The *Favorite* is 173 feet long, 40 feet beam and 16 feet molded depth. Her draft in ordinary trim is 7 feet 6 inches forward; 12 feet 6 inches aft, and with water ballast she can be trimmed to an even keel of 9 feet 6 inches. She is equipped with a 35-ton crane of the locomotive type without trucks, which is located above the pilot house. The crane is equipped with a 3-ton ore bucket. The vessel has a dynamo for furnishing lights for the crane and boom for night work.

The boat has a patent steam windlass and patent anchors of 4,000 pounds each, and 2,000 feet of 1¾-inch stud-link anchor chain, with two mooring engines with wire mooring lines located on the forecastle deck, and a steam capstan on the after deck, with towing machine with 1,200 feet of 2¼-inch wire towing cable, also located on the after deck. There is also a 5-ton crane of the stiff-leg type located on the after end of the house for serving the machine shop. The steering gear is of the Great Lakes Towing Company's design, with cylinders 6 inches and 16 inches diameter by 6 inches stroke.

Her propelling engine is of the fore and aft compound type, cylinders 25 inches and 50 inches diameter by 36 inches stroke, with independent condenser pump. Steam is furnished by three boilers. Each boiler has two Morison corrugated furnaces of 48-inch internal diameter, and 154 boiler tubes 3½ inches in diameter. Each boiler has a separate smokestack all contained in one casing, which is 8 feet in diameter.

A machine shop and blacksmith shop are located between decks in the stern, aft of the engine room, where the lighting plant is located. The lighting plant is divided into four separate units. A large two-stage air compressor and storage tank is provided for furnishing air for pneumatic tools, air hammers and pneumatic drills and divers. The vessel also carries oxy-acetylene tanks and burners and a portable arc electric welding machine.

The machine shop tools consist of a power bolt- and pipe-cutting machine, cutting up to 4-inch pipe or 2½-inch bolts; one engine lathe, 18-inch swing, 8-foot bed; power shaper of 24-inch stroke; drill press; emery wheel; power hack saw and power circular saw mill for sawing lumber.

Living quarters for the crew are all on the main deck, with running water in every room. The equipment includes an artificial ice machine and refrigerator, and water purifier with capacity enough to furnish all the water required by the crew for all purposes. The steamer is equipped with wireless telegraph and long-distance phone.

The wrecking outfit consists of a full equipment of steam pumps and their fittings, ranging in size from 4-inch suction to 16-inch diameter; thirty hydraulic jacks of 100 tons capacity each; two portable air compressors; ship chandlers stores; three sets of diving outfit, and submarine electric lights.

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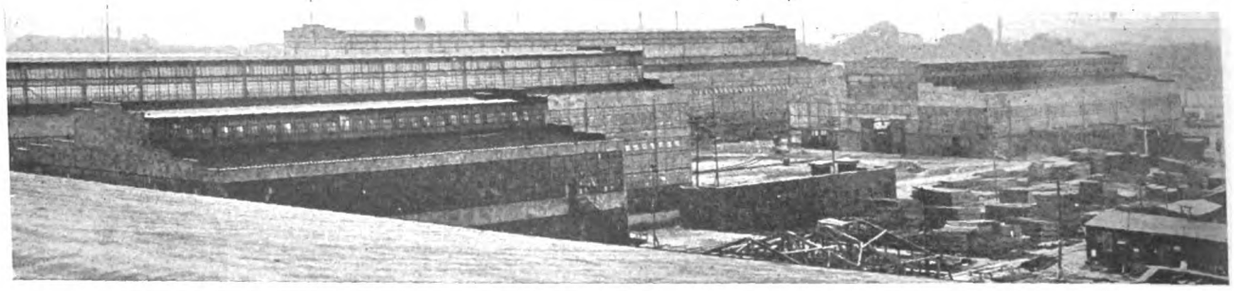

Fig. 1.—General View of the Principal Shops at the Federal Yard, Taken from Roof of Fabricating Shop. Joiner Shop and Machine Shop to the Left. Boiler Shop in Center. Forge Shop and Lumber Storage to the Right

Yard of the Federal Shipbuilding Company

Fully Equipped Steel Shipyard With Twelve Launching Ways Built at Kearny, N. J., by Subsidiary of United States Steel Corporation

ONE of the largest shipyards erected on the Atlantic coast during the war was that of the Federal Shipbuilding Company at Kearny, N. J., on the Hackensack River. The Federal Shipbuilding Company is a subsidiary of the United States Steel Corporation, and, with the cooperation of other subsidiaries of the parent organization, offers exceptional advantages for the production of vessel tonnage in quantity.

In order to meet immediate war needs, the Federal Shipbuilding Company has so far confined its efforts to the building of one type of ship, a single-screw cargo vessel of about 9,600 tons deadweight capacity, although the equipment of the yard and the size of the building ways are sufficient to accommodate vessels up to 15,000 tons deadweight.

Construction of the yard began in August, 1917. The first vessel was launched in June, 1918, and delivered early in October, 1918. Up to the present time, ten vessels have been delivered from the yard, and its present capacity, with a working force of about 8,000 employees, is sufficient for the production of twenty-four vessels annually.

The yard occupies a site comprising 170 acres, with a waterfrontage on the Hackensack River of 2,400 feet. Originally ten shipways were erected, but this number has been increased to twelve. All of the shipways are of timber construction carried on wooden piles. Tracks of the Newark branch of the Central Railroad of New Jersey extend along the southern and western boundaries of the yard, and tracks of the Pennsylvania Railroad enter the yard from the western side. In the northwest corner of the yard, adjacent to the main railroad tracks, is a classification yard for the storage, sorting and classification of fabricated material. As shown by the general plan of the

Fig. 2.—General View of Shipways from Fitting-Out Basin

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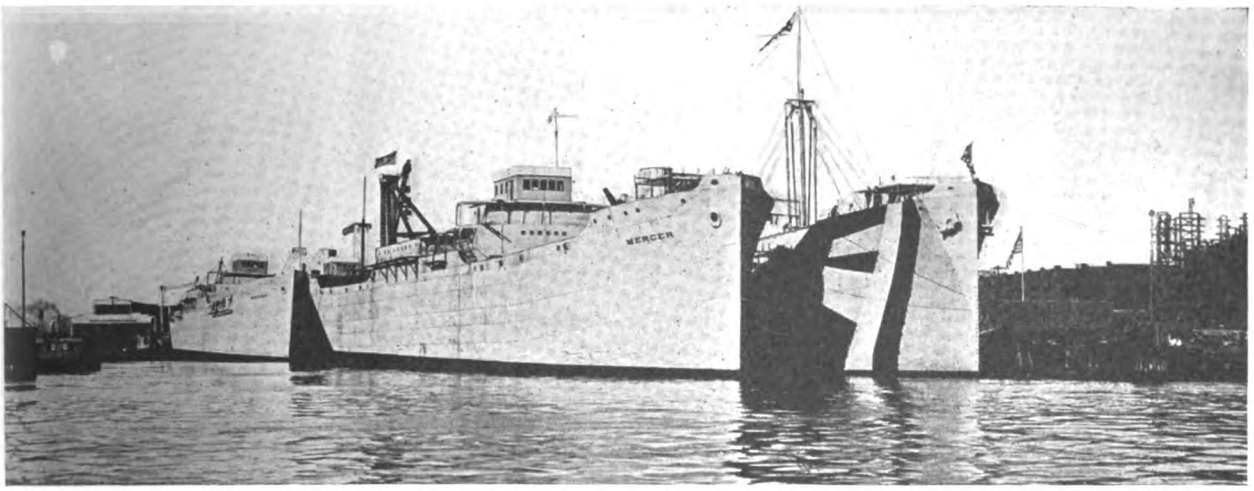

Fig. 3.—Steamships *Mercer* and *Federal*, with Other Vessels, Being Fitted Out in the Wet Basin

yard, standard gage railroad tracks extend to all the shops and down between the building ways. Material is handled throughout the yard by seventeen locomotive cranes, the largest of which have a maximum capacity of 35 tons. Raw material to be fabricated in the yard is stored in space immediately behind the plate shop, served by overhead traveling cranes.

At the shipways, material is handled by portable tower cranes operated by electricity on 40-foot gage tracks between the ways. The length of travel in each case is

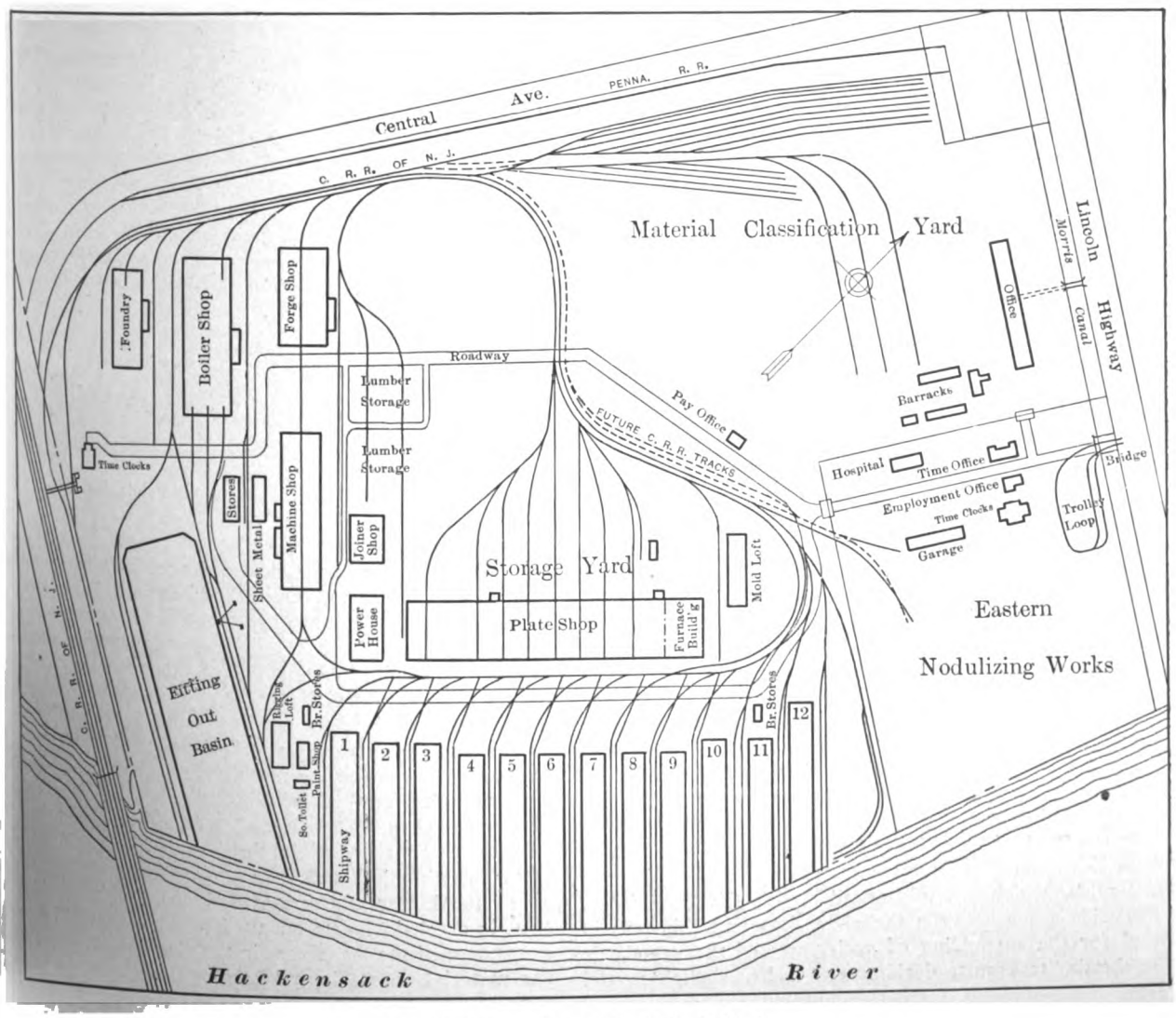

Fig. 4.—General Plan of the Federal Yard

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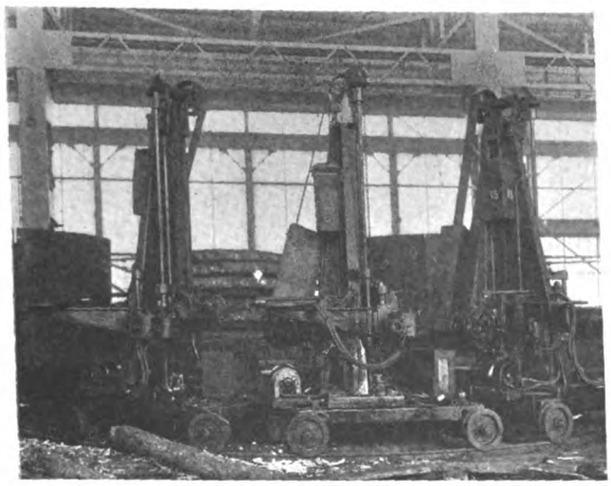

Fig. 5.—Three-Head Boiler Shell Drill in the Boiler Shop

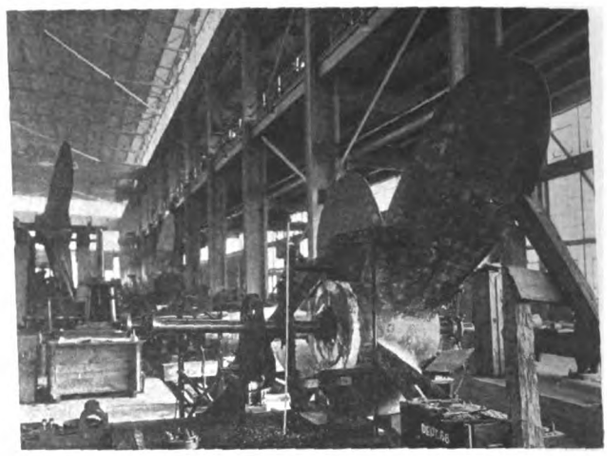

Fig. 7.—Boring Propellers in the Machine Shop

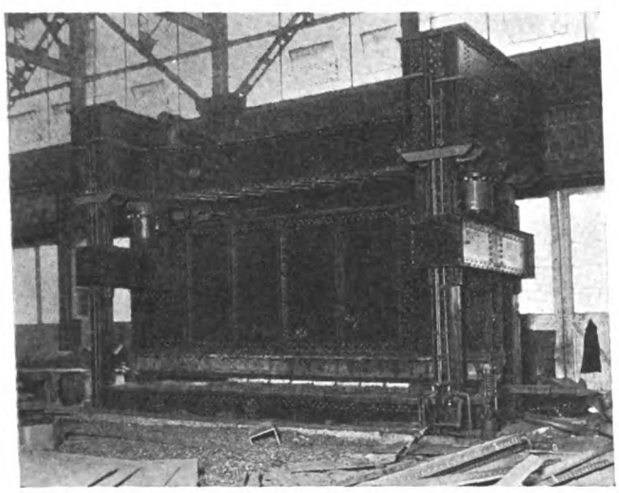

Fig. 6.—Keel-Bending Machine Built at the Yard for the Plate Shop

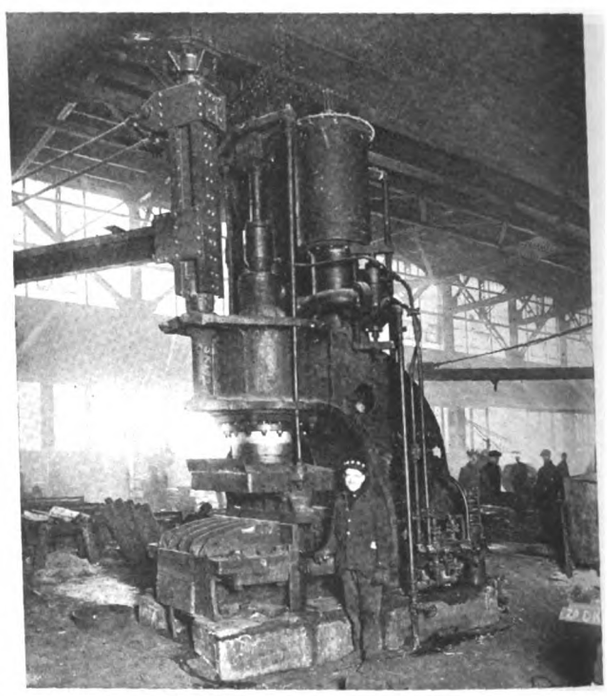

Fig. 8.—Frame Joggling Press in the Fabricating Shop

about 450 feet. There is one tower crane between each pair of ways. With the exception of two of these towers, which carry four derrick booms each, each of the portable towers carries two booms. All of the derrick booms have a capacity of 15 tons at a maximum reach of 65 feet. The lower ends of the derricks are 65 feet above the rails and the towers are built with open frame work, giving a clear height of 20 feet under the towers, so that freight cars and locomotive cranes can pass down the ways underneath the towers. Two standard gage railroad tracks extend down the length of the ways between the tower rails, so that material can be brought on cars to the exact location on the ways where it is to be erected. Space is also available between the ways for the temporary storing of a limited amount of fabricated material. The portable tower shipway cranes were designed and built by the Federal Shipbuilding Company in conjunction with the American Bridge Company.

At the head of the shipways and about 275 feet distant from them is the main plate shop, 800 feet long by 175 feet wide, which extends parallel with the waterfront. The wide space between the plate shop and shipways is used for the assembling of such parts of the vessels as bulkheads, transoms, deckhouses, tanks, skylights, etc. Ground assembly is further facilitated by an overhead crane runway with a span of 71 feet 3½ inches, carrying three electric traveling cranes, one of 35 tons capacity and the other two of 20 tons capacity each, immediately outside of the plate shop. Over the plate yard, immediately behind the plate shop, are two crane runways, on each of which are installed two overhead electric traveling cranes of 10 tons capacity each and two of 5 tons capacity each.

The plate shop itself is divided into three bays extending the full length of the building, each of which is served by three 10-ton overhead traveling cranes. The plate and angle furnaces are at the north end of the shop, and in an extension 120 feet long at this end of the building is the anglesmith shop. The plate shop is thoroughly equipped with the latest types of fabricating machinery. Material at the punches is handled on Lysholm punch tables, and all of the larger machines are equipped with individual electric or chain hoists operated on jib cranes. The arrangement of the machinery in the plate shop is such that the material passes in progressive steps from the plate yard in the rear of the shop to the assembly yard on the way side. Over the plate shop at the southern end are the

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joiner and carpenter shops, while at the northern end is the mold loft.

Down the river, immediately below the shipways, is a wet basin used as a fitting-out berth, which has a capacity for fitting out eight vessels at one time. Near the fitting-out berth are a paint shop, ship riggers' shop, pipe shop and storehouses. A space at the end of the wet basin is reserved for the storage of pipe and fittings. Material is handled at the fitting-out berth by locomotive cranes, and for heavy weights such as boilers and engines a stationary three-leg jib crane of 100 tons capacity has been erected. This crane was designed and built by the Federal Shipbuilding Company in conjunction with the American Bridge Company.

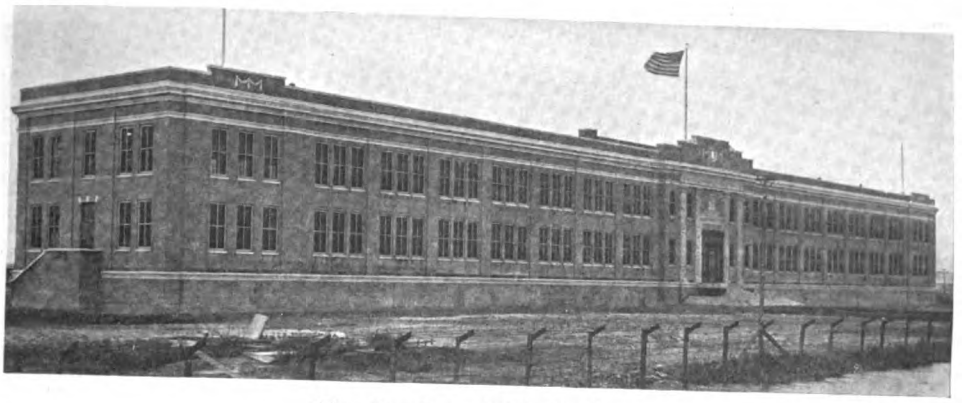

Fig. 10.—General Office Building

In addition to the plate shop, the yard is equipped with a machine shop, forge shop, boiler shop, foundry and carpenter shop. Each department is housed in a separate building, and all of the buildings are of steel, glass and tile construction.

Power is furnished from the Public Service station in the form of electricity at 13,000 volts, which is stepped down to 2,200 volts for operating the air compressors, 440 volts alternating current and 250 volts direct current for general machine use, and 110 volts single phase for lighting purposes. In the power house are five air compressors supplying a total of 22,000 cubic feet of free air per minute. Two of the compressors are Ingersoll-Rand machines, one with a capacity of 5,400 cubic feet and the other of 2,700 cubic feet of free air per minute. The other three compressors are of the Laidlaw-Dunn-Gordon cross compound type, each with a capacity of about 4,400 cubic feet of free air per minute. In the power house there is also a hydraulic plant with a capacity of 450 gallons per minute at 1,500 pounds per square inch pressure, consisting of three Dean hydraulic pumps and two accumulators supplied by the Camden Iron Works.

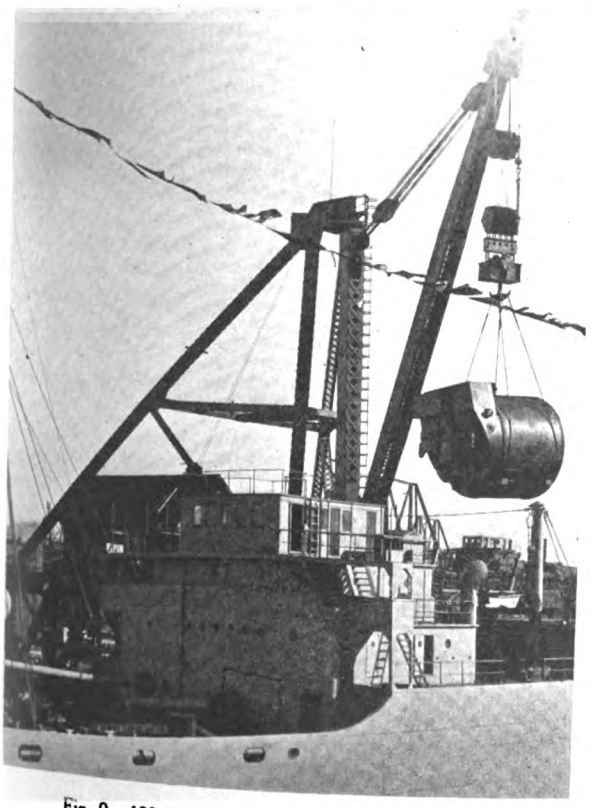

Fig. 9.—100-Ton Crane at the Fitting-Out Berth

Machine Shop

The machine shop is 500 feet long and 123 feet 8½ inches wide, with two side balconies each about 30 feet wide. In the central bay are two 50-ton Cleveland overhead electric traveling cranes, each of which has a 10-ton auxiliary hoist. The heavy planers and boring machines for machining stern frames, propellers and shafting are in the center bay, while the lathes and lighter machinery are in the north and south bays. As yet, the Federal Shipbuilding Company has not begun the manufacture of propelling machinery, although the machine shop is being equipped with suitable facilities for this work whenever it is found advisable to undertake engine building.

A special feature of this yard is the splendidly equipped shop for building Scotch boilers. The shop itself is 500 feet long and 161 feet 6 inches wide, to which an extension 85 feet long is being added. The shop has a capacity for turning out annually 175 three-furnace, single-end Scotch boilers each 15 feet 6 inches diameter by 11 feet long with a heating surface of from 3,500 to 3,600 square feet.

Equipment of Boiler Shop

The shop is divided into three bays. The center bay is served by three overhead electric traveling cranes of 50 tons capacity each; the eastern end of the bay is utilized as an erecting floor, and the western end for the bending, drilling and riveting of the heavy shell plates. The equipment here includes a set of Southwark vertical bending rolls; one 200-ton bull riveter; one 150-ton bull riveter; two 75-ton bull riveters and two 90-ton portable riveters; one three-head Bethlehem shell drill, and one three-head shell drill built at the yard. In the south bay are the machines for punching, shearing, planing and drilling the plates. The equipment includes sixteen radial drills, several long-arm radial drilling and countersinking machines, three plate planers, bending rolls, etc. Jib cranes with chain hoists are provided for handling material at the larger machines, and this bay is also equipped with two 20-ton overhead electric traveling cranes with 5-ton auxiliary hoists. At the west end of the bay are the furnaces and bending slabs and sectional flanging machines. The northern bay, served by two overhead traveling cranes, is

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used principally for the lighter sheet metal work, such as casings, uptakes, tanks, etc.

The forge shop is 300 feet long by 151 feet wide. Part of this building is used as a drop forge shop and is equipped with six Erie steam hammers ranging from 400 pounds to 2,000 pounds, two Ajax riveting machines and a die sinking department. The rest of the building is taken up with solid smith work, for which six Erie single-frame steam hammers, ranging from 800 to 1,500 pounds, are provided. There is also a United Engineering 350-ton hydraulic press. The center bay of this shop is served by a 15-ton overhead electric traveling crane supplied by the Erie Steel Construction Company.

In addition to the above, there is a foundry 300 feet long by 103 feet wide equipped with two iron cupolas, each with a capacity of 12 tons. The foundry is also provided with equipment for furnishing brass castings up to one ton. The center bay of the foundry is equipped with two 20-ton Milwaukee overhead traveling cranes.

The main offices of the company are located in a two-story general office building 420 feet long by 55 feet wide, near the main entrance. The administration offices are on the first floor of the building and the engineering department on the second floor. At the main entrance are the time clocks and employment offices, and nearby is a well-equipped emergency hospital.

American Shipbuilding Company Launches 108 Vessels Aggregating 389,000 Tons Deadweight in Sixteen Months

FIFTY-FOUR percent of the total tonnage turned out on the Great Lakes for the emergency fleet was produced from the yards of the American Shipbuilding Company, Cleveland, Ohio. During the sixteen months beginning August, 1917, and ending November, 1918, this company launched 103 ships aggregating 362,000 tons deadweight for the Emergency Fleet Corporation, and, in addition, three bulk carriers aggregating 27,000 tons deadweight for Great Lakes service and two special steamers for the United States Navy, or more than the total output of American shipyards during any one year prior to 1917.

When navigation opened in the spring of 1918 a completed fleet of 16 vessels, which had accumulated at the various plants of the American Shipbuilding Company during the winter of 1917-18, sailed for the seaboard, followed at intervals by 71 more vessels before the close of navigation in 1918. These vessels are of the standard Great Lakes single-deck type of ocean carrier, 261 feet long overall, 251 feet between perpendiculars, 43 feet 6 inches beam and 21 feet 2 inches depth of hold, fitted with reciprocating engines of 1,200 indicated horsepower, designed to give the ships a speed of 9½ knots. Sixty more vessels of the same type, but of larger size, will be delivered in 1919.

The American Shipbuilding Company controls eight separate plants, seven of which are in the United States and one in Canada. Six of these plants are equipped for building ships, and during the past year the output was at the rate of twelve ships a month from all the yards.

This immense output from the yards of the American Shipbuilding Company was not accomplished without a considerable increase in the facilities at the various yards. Both the boiler and machine shops operated by the company in Detroit, Mich., were doubled in capacity, and the additional shipways provided are shown in the following table:

Location of Yard	Original Number of Shipways	Present Number of Shipways
Wyandotte	4	10
Lorain	8	8
Cleveland	2	3
Buffalo	1	3
Chicago	2	5
Superior	3	5
Total	20	34

During the war, night shifts were employed in the plate shops, but not on the hulls. In all, about 12,500 employees were engaged in this work. The plants controlled by the American Shipbuilding Company are the following: American Shipbuilding Company (Globe plant), Cleveland, Ohio; American Shipbuilding Company, Lorain, Ohio; Detroit Shipbuilding Company, Detroit, Mich.; Buffalo Dry Dock Company, Buffalo, N. Y.; Chicago Shipbuilding Company, South Chicago, Ill.; Western Dry Dock & Shipbuilding Company, Ltd., Port Arthur, Ontario, Canada; The Superior Shipbuilding Company, Superior, Wis., and Milwaukee Dry Dock Company, Milwaukee, Wis.

National Merchant Marine Association Organized to Aid the Development of the American Merchant Marine

AT a preliminary conference of men interested in shipping, shipbuilding and maritime affairs, held in Washington on January 22 and 23 under the leadership of Senator Joseph E. Ransdell, of Louisiana, it was decided to organize a national association, to be known as the National Merchant Marine Association, for the purpose of aiding and developing a plan and programme under which an American merchant marine can be practically and successfully established. At this meeting a council was appointed to act as the governing body of the association. At a subsequent meeting of the newly-appointed council on March 17, Senator Joseph E. Ransdell was elected president of the association. Further steps in the organization of the asociotion resulted in the election of an executive committee and four vice-presidents. The results of the election, as well as the names of the members of the council, are published elsewhere in this issue.

It is the purpose of the newly organized National Merchant Marine Association to aid in the development of a merchant marine under the American flag adequate to the needs of the American commerce and to provide the merchant ships adequate to meet the military and naval requirements of the country in time of war. The association is composed of some of the best-informed and most influential men in the marine industries, and it is to be their main business as an organization to develop all facts relating to the need of the United States for having a merchant marine under its own flag and to develop and suggest to Congress a shipping policy and laws which will promote the best interests of the country as a whole. The immediate necessity, of course, is to develop and advance practical suggestions for the disposal of the tonnage already built or contracted for by the Shipping Board.

The best American talent from all the co-ordinate branches of the marine industries must be depended upon for advice and guidance in developing the new merchant marine under existing conditions, and it is believed that the National Merchant Marine Association, through its organization and resources, will be in a position to render valuable aid in solving this national question.

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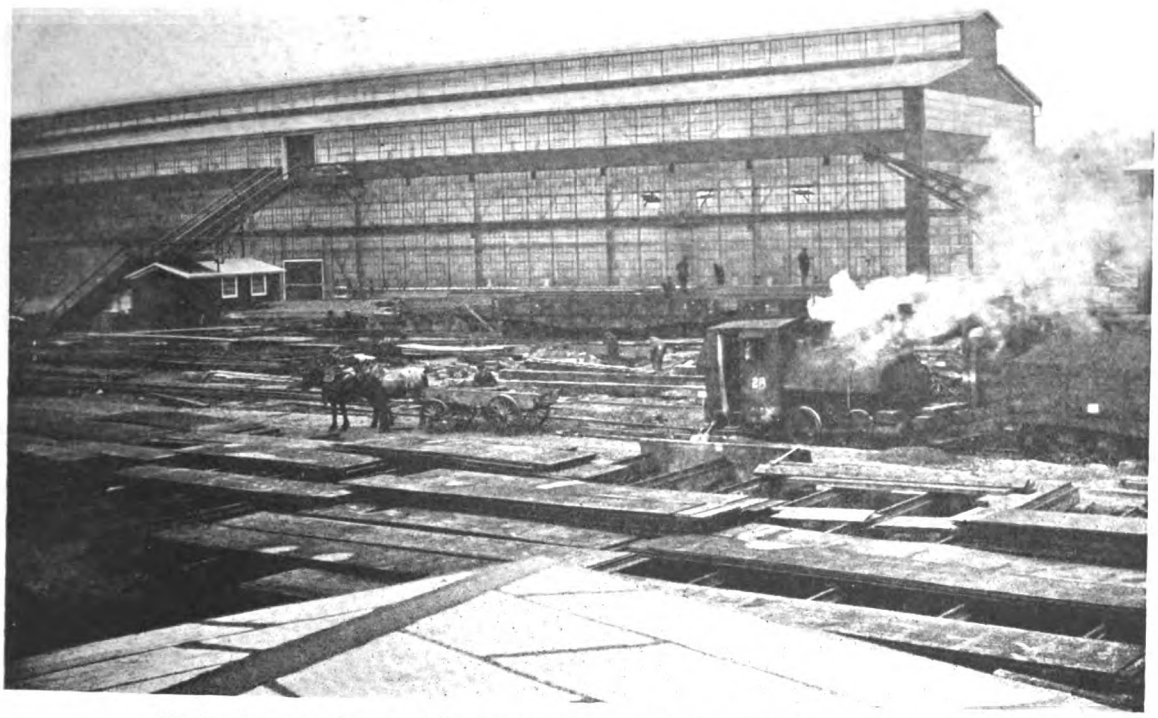

Fig. 1.—Assembling Shop and Mold Loft. Section of Plate Storage Yard in Foreground

Manitowoc Shipbuilding Company

Steel Shipyard on the Great Lakes Quadrupled in Capacity to Meet Demands for Sea-Going Tonnage

DURING the past two years the Manitowoc Shipbuilding Company, Manitowoc, Wis., has practically quadrupled its capacity for building ships. Before the war it had three building ways and could turn out six ships in a year. It now has six building ways and can turn out twenty-four ships annually. Formerly its working force numbered about 750, but at present 2,200 employees are on the payroll. In 1917 four steamships and several steam trawlers were built at the yard; in 1918 the output consisted of twelve standard Emergency Fleet vessels; in 1919 the company's schedule calls for the delivery of twenty-four ships.

Development of the Plant

The phenomenal growth of this shipyard represents what in ordinary times might be accomplished in perhaps ten to fifteen years of steady development. Needless to say, advantage has been taken of the opportunity to build up the company's resources in equipment and organization so that the plant embodies the latest ideas and facilities for ship production. The Manitowoc yard is fully equipped for building not only hulls and propelling machinery, but many of the deck and engine room auxiliaries, including winches, windlasses, steering gear, pumps, condensers and the like, as well as much of the equipment of a steamship, including lifeboats. In this respect the Manitowoc yard is a notable exception to the average shipbuilding establishment on the Great Lakes. About the only equipment which comes from outside the yard is the electrical apparatus, independent pumps, refrigerating machinery, navigating instruments, etc.

The Manitowoc yard is situated on a peninsula 2,000 feet long by 800 feet wide covering 35 acres on the Manitowoc River about a mile from Lake Michigan. The yard has a waterfront of one mile, with a depth of water around the peninsula of about 21 feet. Two railroads, the Chicago & Northwestern and the Soo Line, connect with the yard. Three sources of power are available, the Wisconsin Public Service (High Falls), the Reiss Coal Company, which is located across the river from the shipyard, and a power plant in the shipyard. The Public Service current is received at 4,000 volts and stepped down in transformers to 440 volts for the compressor motors and certain alternating current motors in the yard. Part of the alternating current is converted in General Electric synchronous rotary converters to 250 volts direct current, which is used for variable speed cranes and other direct-current equipment. Power from the Reiss plant is received at 250 volts direct current and used for the balance of the power and lighting requirements. The yard plant has three 40-kilowatt generators, which are used principally for operating the pumps of the dry docks.

Power Plant

The average power requirements at the yard are from 1,500 to 2,000 horsepower. The air compressor equipment includes three Ingersoll-Rand machines, one with a capacity of 2,400 cubic feet, one of 1,200 cubic feet, and the

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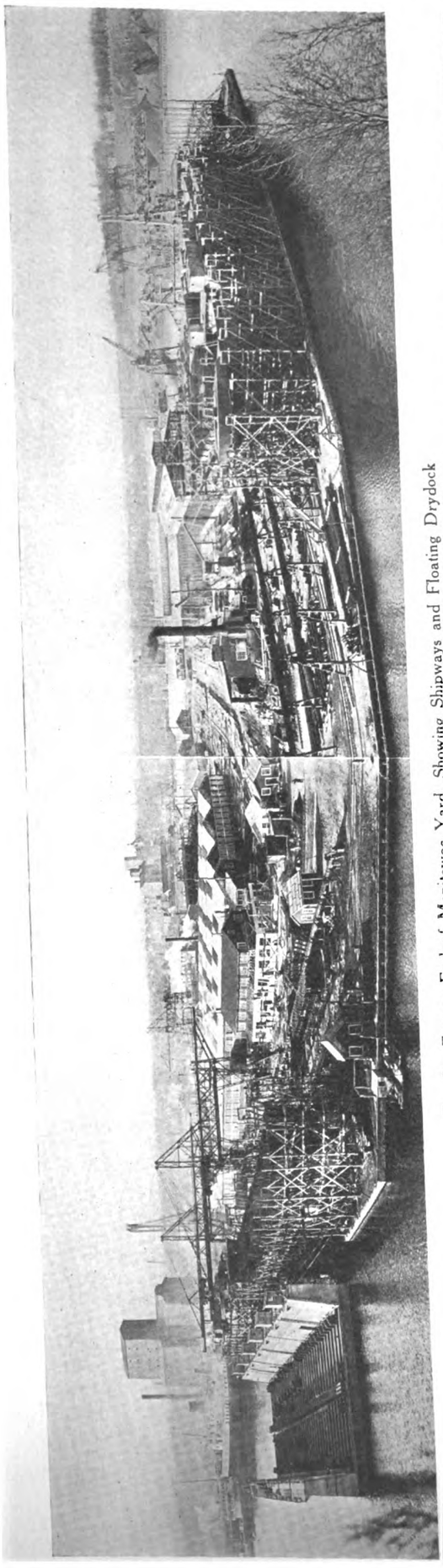

Fig. 2.—Eastern End of Manitowoc Yard, Showing Shipways and Floating Drydock

Fig. 3.—Machine Shop. Building is of Steel Frame Construction With Glass Sides. Gallery at Left for Light Machine Work

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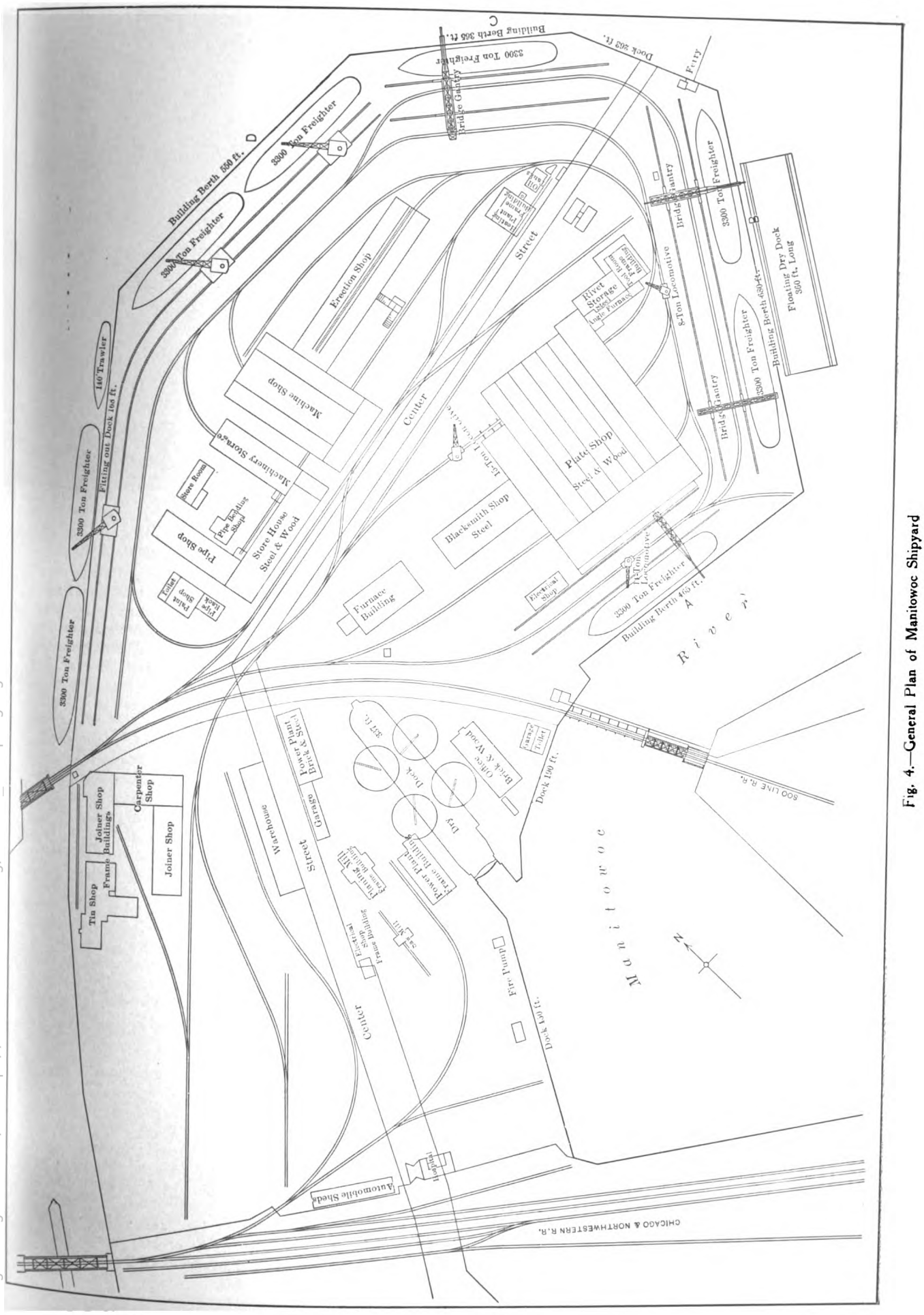

Fig. 4.—General Plan of Manitowoc Shipyard

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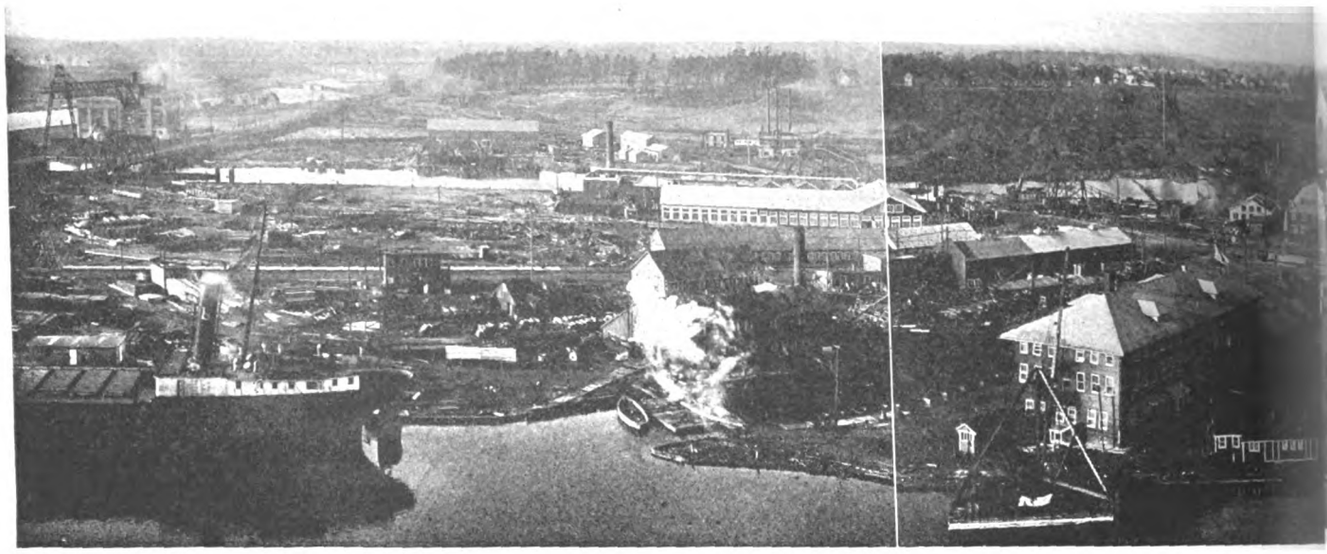

Fig. 5.—Panoramic V

third of 600 cubic feet of free air per minute, and two Chicago pneumatic tool compressors of 1,100 cubic feet capacity each. There is also a compressor of 300 cubic feet capacity in the machine shop, which is used to take care of night work.

The compact arrangement of the yard is shown in the general plan, Fig. 4. The six building berths, placed end to end around the circular end of the peninsula, are of timber construction. The keel blocks rest on timbers, which in turn rest on two rows of wooden piles. Footings for the bilge shores also rest on wooden piles. Along the outer edge of the ways is a bulkhead built of wood piles and triple-sheet piling anchored back to wooden piles. On account of the circular shape of the peninsula, the various shops are most advantageously located with respect to the departments which they are to serve. A roadway, or street, extends down through the center of the yard, and spur tracks from both railways lead to the storage yards and shops.

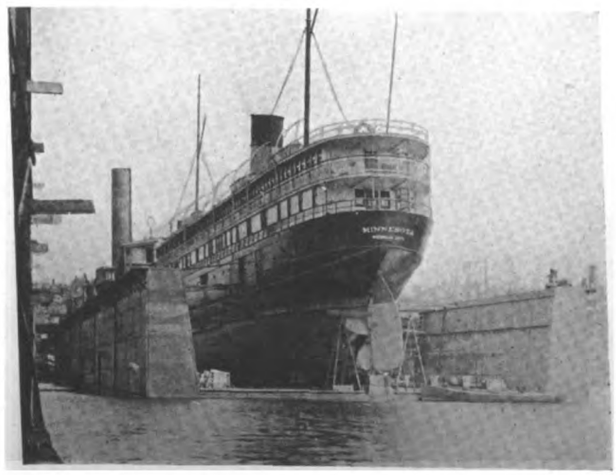

Fig. 6.—Floating Dry Dock

Method of Storing Material

An outstanding feature of the yard is the arrangement for storing material. Storage space for fabricated material in connection with large storage space for raw material gives a production "cushion" on both sides of the fabricating operation. Fabricated material properly classified is piled beside each ship on the ways. Most of the carload material enters the yard on the Soo Line spur. Ample space is provided so that material can be stored in piles lying flat on skids, the plates being arranged by strake letters and frame numbers so that a ship fitter can lay out the top plates on each pile rapidly, and as fast as they are taken away by a locomotive crane the operation can be repeated for another ship. The large storage space, provided with ladder arrangement of spur tracks, giving quick access to material in any part of the yard, has proved a vital factor in the efficient operation of the plant. Altogether there are over three miles of railroad tracks in the plant.

The material is carried to the shops and ways by locomotive cranes. The company has an 11-ton switching locomotive, two Link Belt 15-ton 40-foot boom and one Browning 18-ton 50-foot boom locomotive cranes for this purpose. They also have two Davenport gasoline (petrol) cranes, one of 15 tons capacity with a 40-foot boom, and the other of 10 tons capacity with a 30-foot boom.

Shipway Cranes

At the building berths material is handled by gantry cranes. At all of the berths but one the gantries are of a bridge type of four tons capacity, designed by the Manitowoc Shipbuilding Company. They are 47 feet high, mounted on an elevated 70-foot gage track, and extend over the building berths as well as a short distance over the storage space on the inland side of the gantry tracks. Each crane has two hoisting drums. The controller hoist runs back and forth with the load, and, as it is provided with glass sides and bottom, the operator always has an unobstructed view of the movements of the load.

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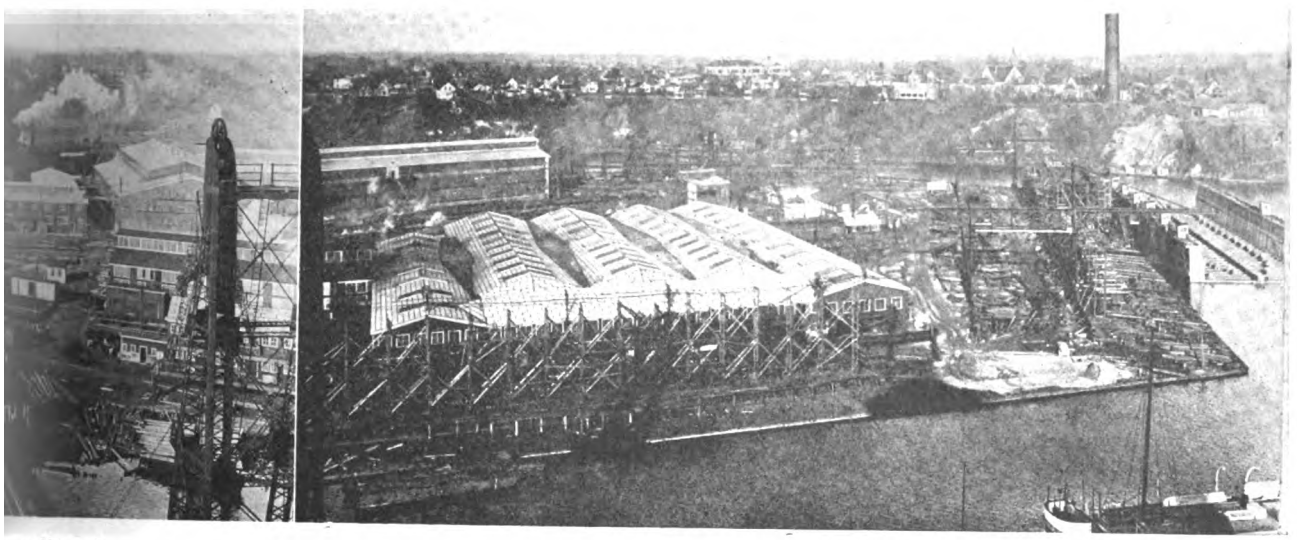

owoc Shipyard

Two other gantries, which serve the two northern building berths are McMyler tower erecting cranes with 98-foot booms. These cranes have a capacity of 6 tons each at a 53-foot radius and travel on a 24-foot 2½-inch-gage track. In addition to the above equipment, the company has added another 15-ton McMyler gantry for the heavy lifts and a light locomotive crane with a 70-foot boom for the fitting-out berths.

The outfitting dock is about 800 feet long, with a capacity for three standard ships. An additional outfitting berth of about the same capacity has been added, which will be a continuation of the present berth and double the capacity.

Plate Shop

The shops at the plant include a plate and shape shop, blacksmith's shop, boiler shop (situated a mile down the river from the plant), machine shop, forge shop, pipe and plumbing shop, tin shop, electrical shop, carpenter and joiner shop, and paint shop. There is also an assembly shop with mold loft above and a plate furnace shop.

The plate shop is 350 feet long by 260 feet wide, divided into eight bays. The outside bays are served by 2-ton mono-rail hoists, and the center bays by hand-control chain hoists. One-half of the shop is used for laying out and furnacing the plates and one-half for punching, shearing and bending. At the punches the plates are handled on roller skids of a special type built at the yard, while at the shears the plates are handled by chain hoists having straight-line motion parallel with the shears. The plate shop contains light and heavy bending rolls, a joggle press for frames and an hydraulic cold flanging machine.

In general, all plates enter the punch shop transversely at the northern end and travel south through the shop. Channels for frames enter at the northern corner, where they are bent and then moved westward and pass through the west side of the shop. Angles enter the shop at the southern end and are worked transversely through the shop.

All floors are assembled in the plate shop along the eastern end, while the other ground assembling is done either out of doors or in the assembly shop. All bulkheads, tran-

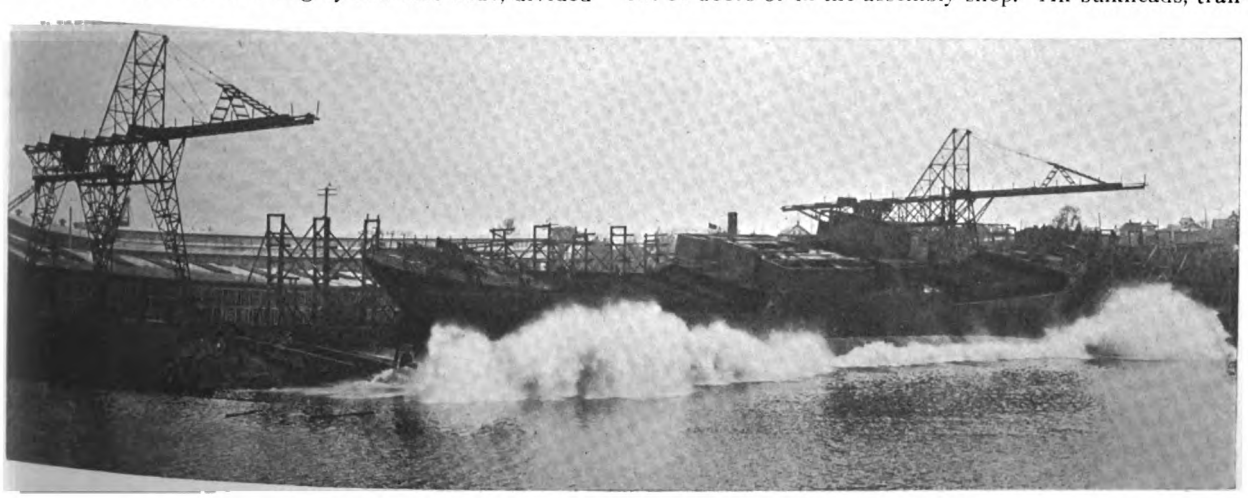

Fig. 7.—Launching of Vessel at One of the Shipways

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Fig. 8.—Gallery in the Machine Shop

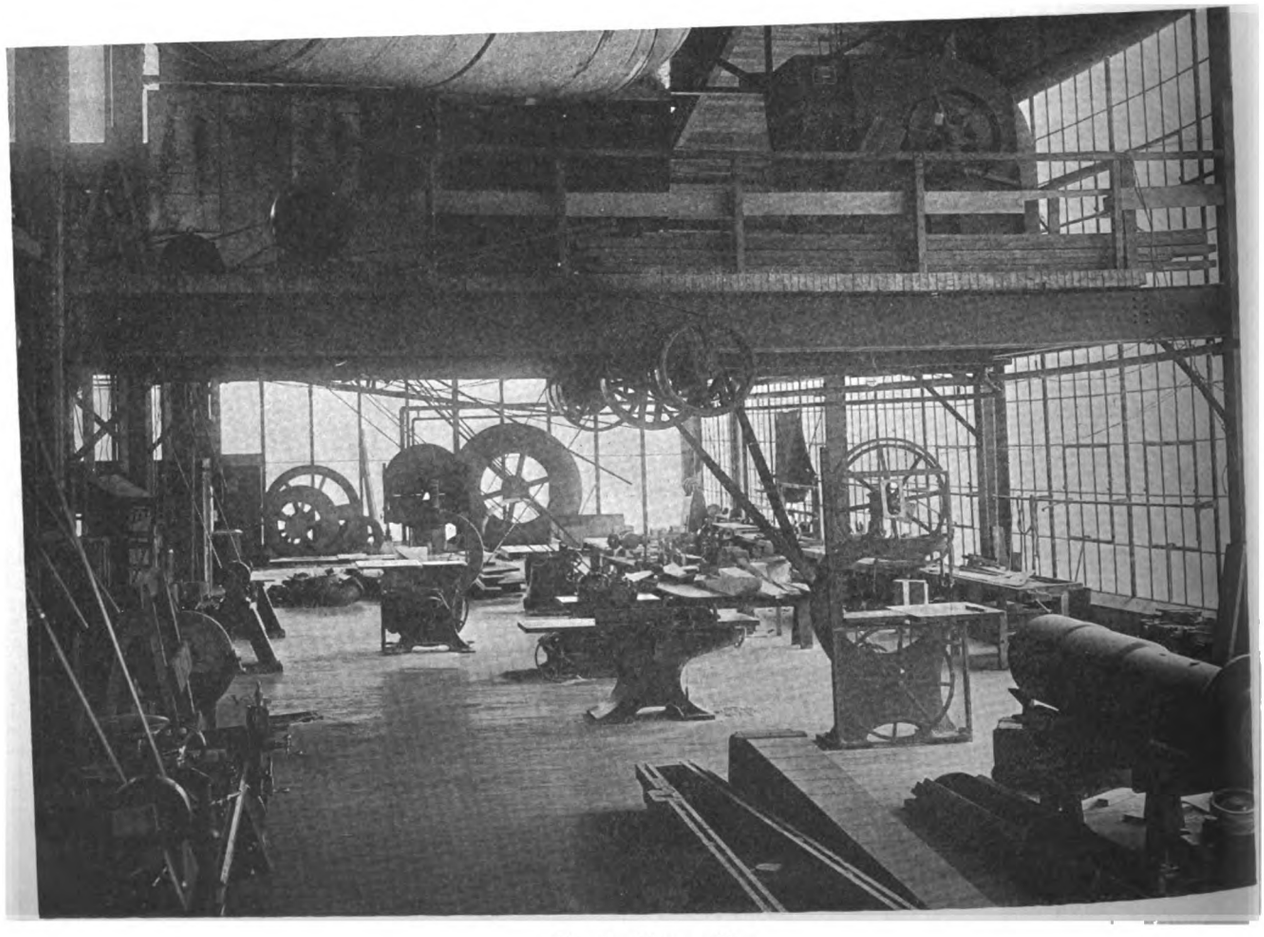

Fig. 9.—Pattern Shop

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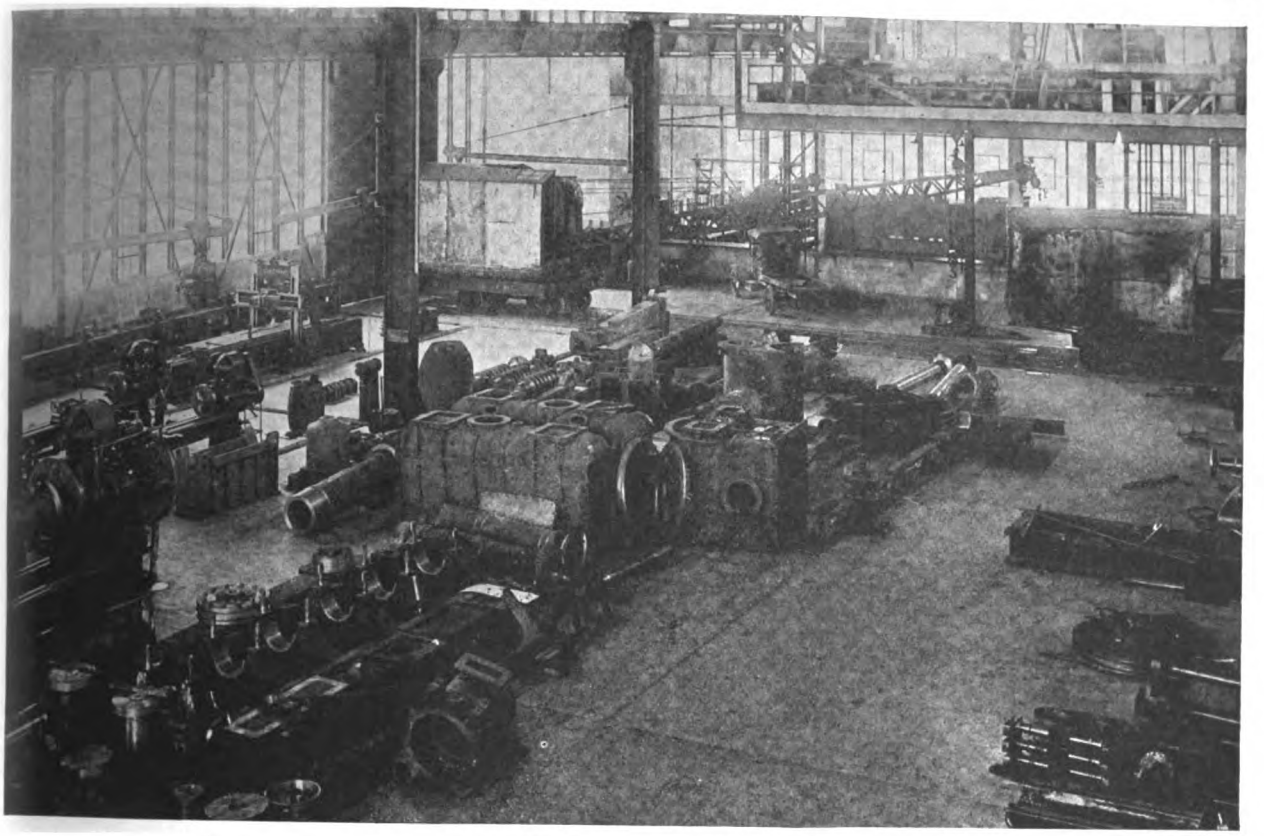

Fig. 10.—Corner of Machine Shop

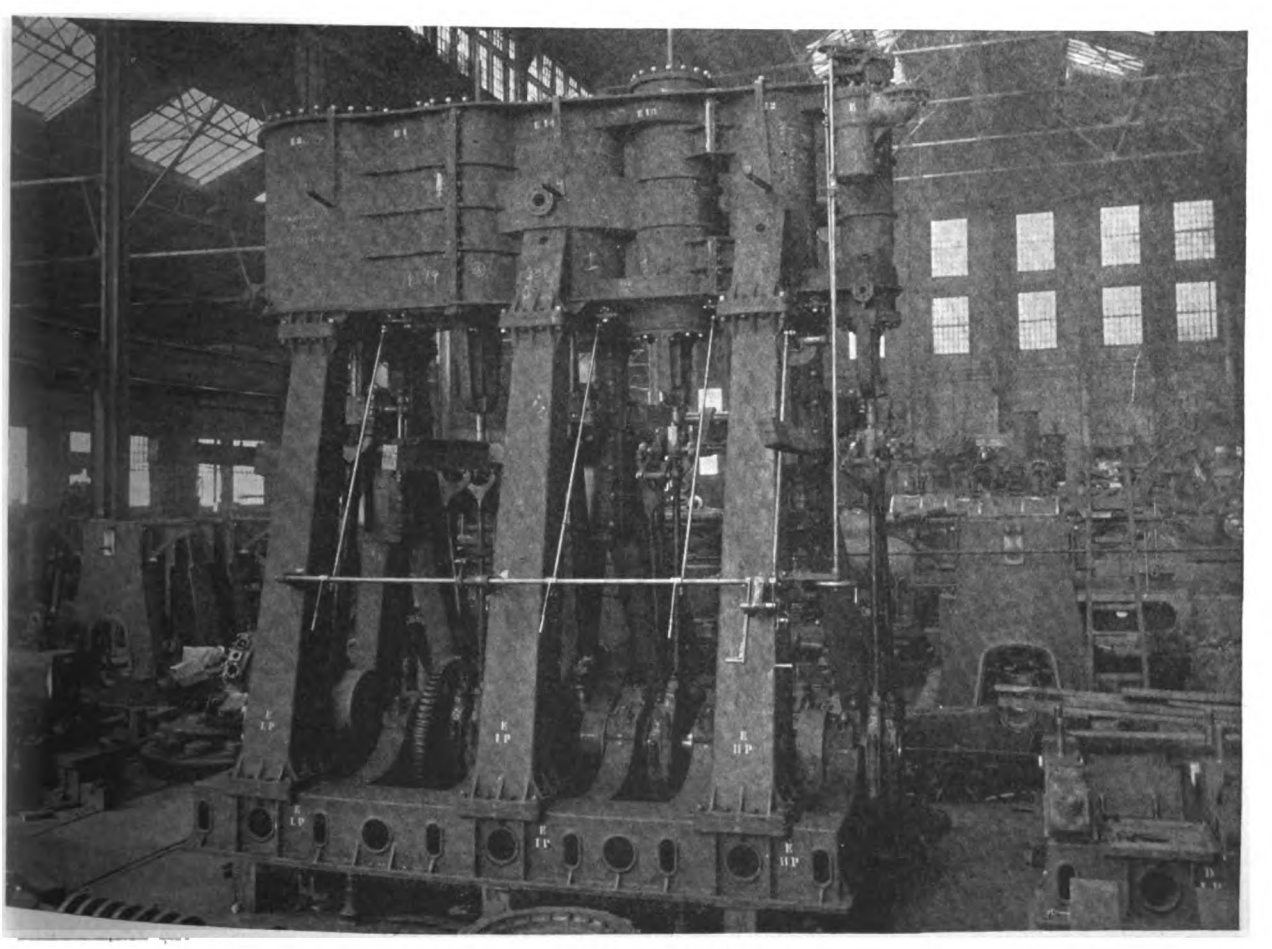

Fig. 11.—Erection Floor of Machine Shop

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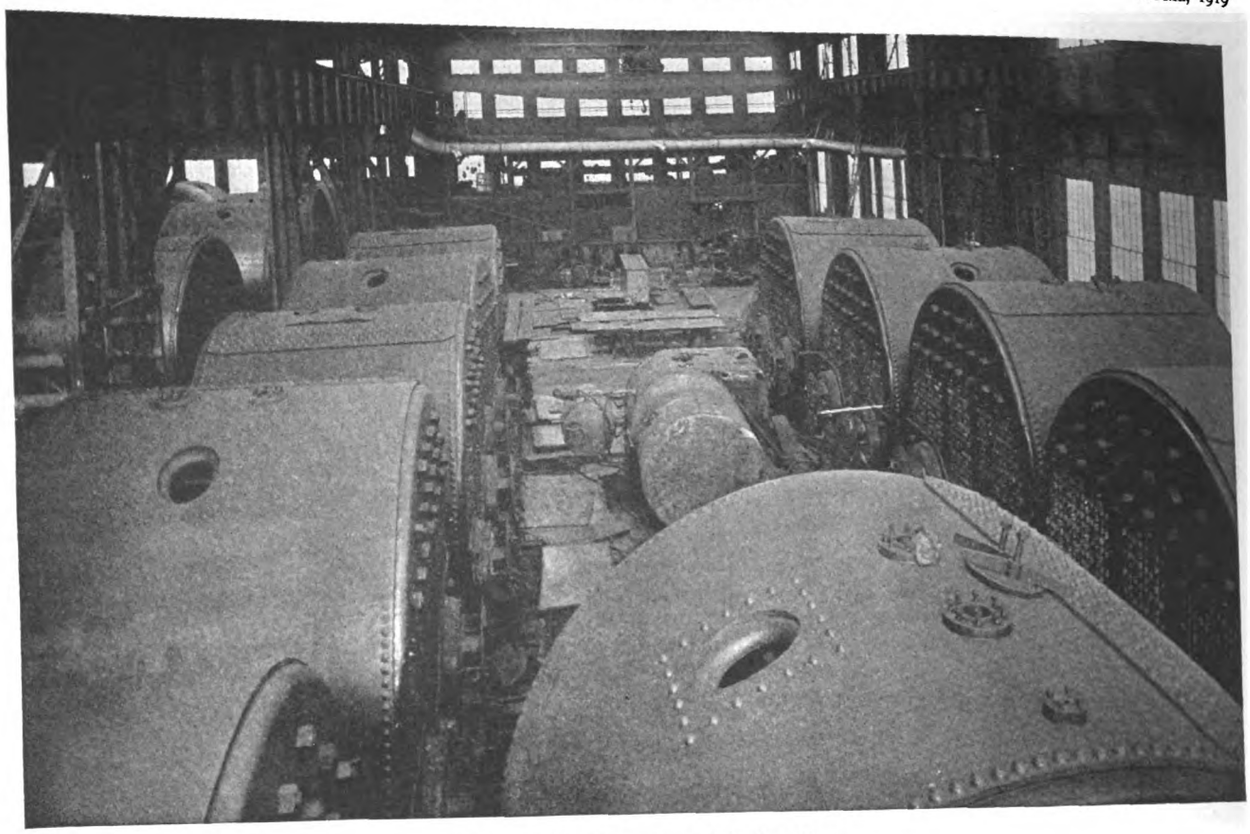

Fig. 12.—Erection Floor of Boiler Shop

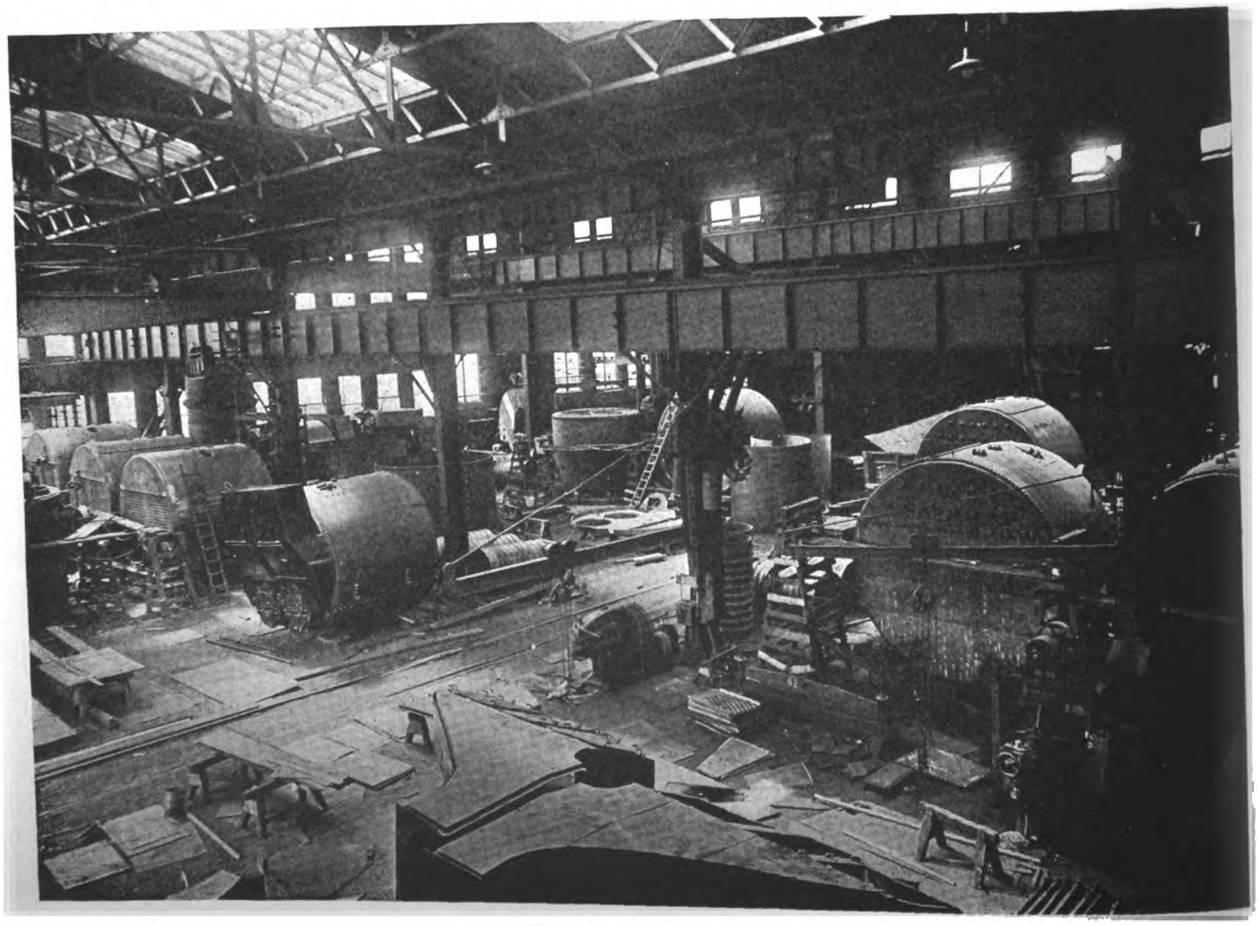

Fig. 13.—Central Bay of Boiler Shop

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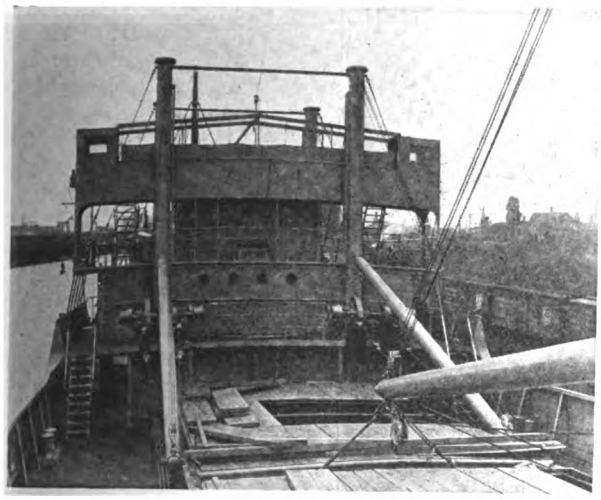

Fig. 14.—Deck of Motorship Amidships

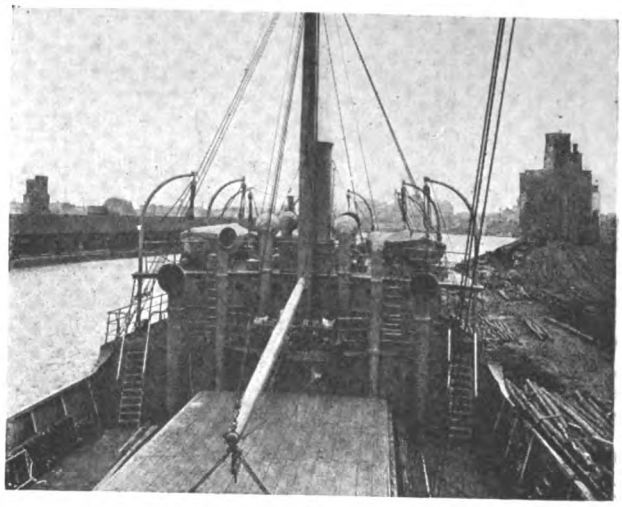

Fig. 15.—Deck of Motorship, Looking Aft

soms, small tanks and floors are assembled in the assembly shop or on the ground.

Equipment of Machine Shop

One of the finest shops in the plant is the new machine shop, 224 feet long and 124 feet wide, of steel frame construction with glass sides. This shop is divided into three bays. The center bay is equipped with a 15-ton Pawling & Harnischfeger overhead electric traveling crane and is used for the assembling floor as well as for the largest machines in the shop. The north bay is used for the large lathes, planers, milling and boring machines, which are served by jib cranes and, where necessary, with air hoists. The south bay, with a gallery above, is used for light machine work. At the east end of the building a width of 35 feet is used for tool and locker rooms and offices. Above this is a gallery, which is used for the pattern shop.

The assembly shop, 300 by 60 feet, with the mold loft above, is of the same type of construction as the machine shop.

The blacksmith shop, located near the plate shop, is equipped with three steam hammers, one of 2,500 pounds, another of 1,500 pounds, and a third of 600 pounds, a 350-pound electric hammer and two light air hammers. The pneumatic forging hammer is especially useful for light work, such as drift pins, chisels, etc.

All of the rivets used at the plant are made with two Ajax machines in a special shop arranged for that purpose.

Two well-equipped tool rooms are provided, one for the repair of pneumatic tools in the yard and the other in connection with the machine shop.

Repair Facilities

In addition to the building of ships, the company has previously handled a large amount of ship repair work, and for this work has two dry docks, one a steel sectional floating dry dock, built at the yard four years ago, having a capacity for docking ships 420 feet long, and the other a graving dock 337 feet long.

Another important feature of the plant is the boiler shop situated a mile down the river, where the equipment is ample for turning out two large Scotch boilers a week. The boiler shop is also engaged in a variety of heavy plate work, such as paper-making machinery, digesters, tanks, etc.

The main offices of the company are located in a three-story brick building in the yard. On the first floor are the

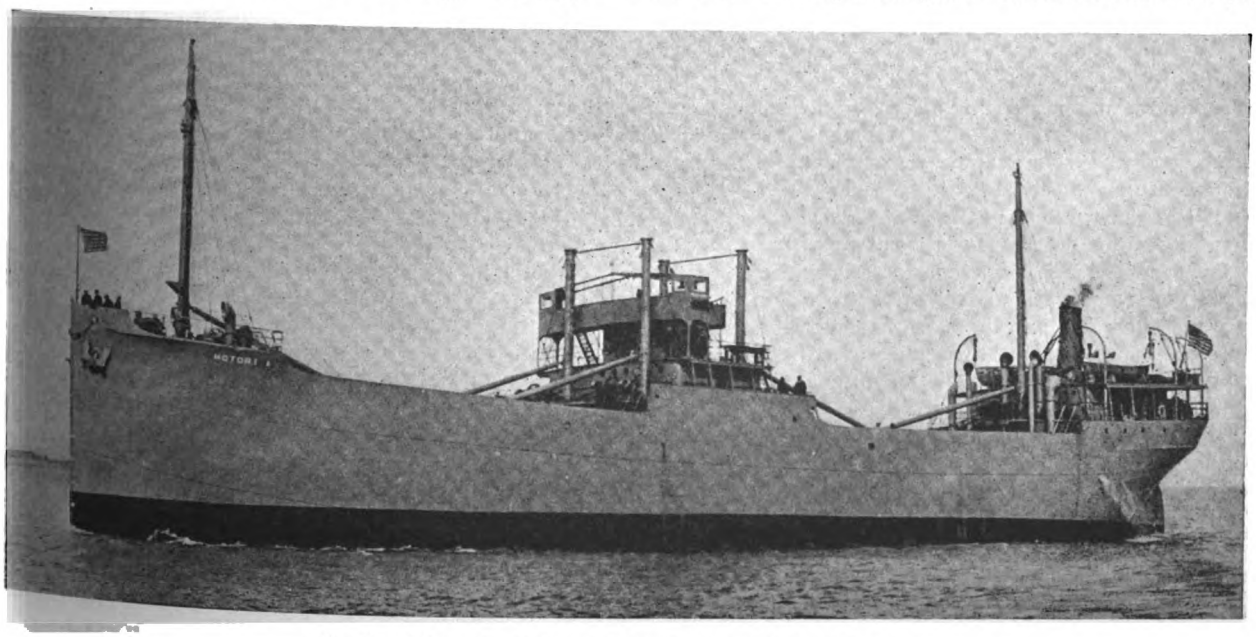

Fig. 16.—Motorship Built by Manitowoc Shipbuilding Company

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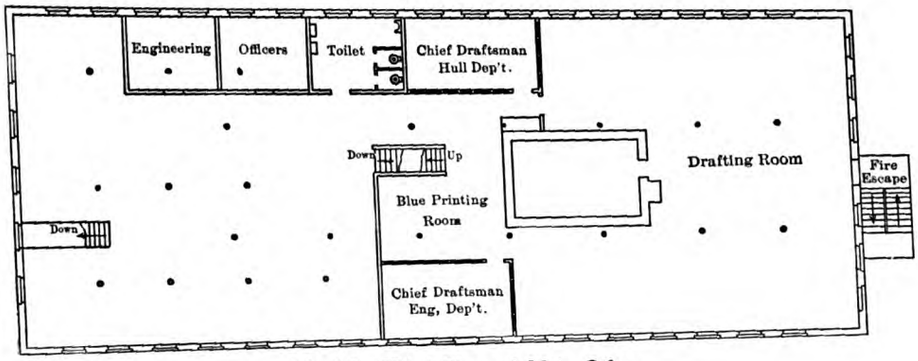

Fig. 17.—Third Floor of Main Office

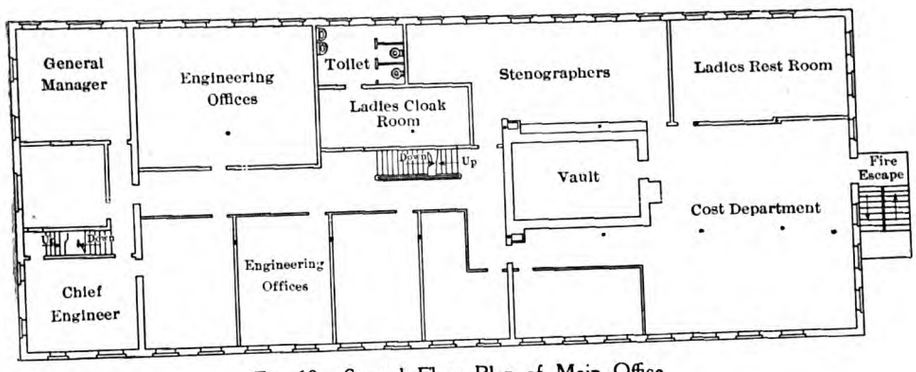

Fig. 18.—Second Floor Plan of Main Office

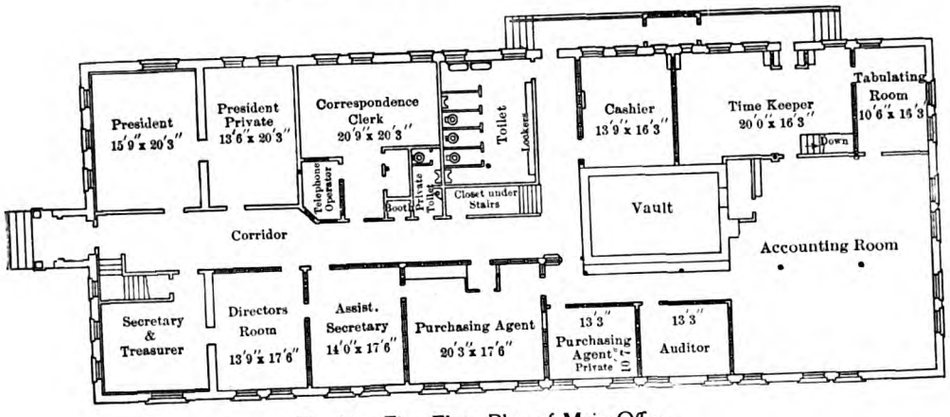

Fig. 19.—First Floor Plan of Main Office

administration and auditing offices, on the second floor the engineering department, offices for the Government officials and the stenographic department. The drafting rooms are on the third floor.

All of the workers in the yard, except the office force, are hired by a central employment department, and labor requirements receive first consideration at a weekly foreman's meeting, presided over by the president of the company. There is also a director of industrial relations. To promote safety, there are regular monthly inspections by three committees—a general committee, a foreman's committee and a workman's committee.

For protection against fire the plant is exceptionally well equipped. Water mains and hydrants are installed in the vicinity of all the buildings, as well as around the shipbuilding berths. The following buildings are equipped with automatic sprinklers: Administration building, general storehouse, machine shop, machinery warehouse, pipe and plumbing shop, rigging loft, carpenter and joiner shops, tin and lifeboat building shop, and lumber storage building.

Welfare and Housing

As a part of the welfare work, there is a completely equipped first aid hospital with a doctor and nurses in attendance and an employees' service club, which publishes a live house organ, *The Keel Block*, and supervises recreations and amusements. The housing problems occasioned by the rapid increase in the working force have been handled by the company in conjunction with the housing division of the Emergency Fleet Corporation. A hundred houses for workmen have been built by the Emergency Fleet Corporation and sixty more by the company, forming an industrial town, called Riverview, near the shipyard. In this connection the company has erected at the entrance to the yard a splendidly equipped restaurant with a capacity of 600 and a dormitory containing 245 rooms, known as the Riverview Inn. Above the restaurant is a recreation room for occupants of the dormitory. The dormitory itself is a two-story building constructed with three wings, so that all of the rooms are outside rooms. On each floor are splendidly equipped baths and showers, and the dormitory is operated with the sole view of providing comfortable and convenient quarters for the workmen.

During the past two years all of the resources of the Manitowoc shipyard have been placed at the disposal of the Emergency Fleet Corporation, and all of the vessels constructed have been of the standard Great Lakes seagoing type of cargo ship of 3,500 and 4,050 tons deadweight. Before the war, the company had built a great variety of steam vessels, including Lake passenger and cargo steamers, steam trawlers, a Coast and Geodetic Survey steamer, motorships and hydraulic and dipper dredges.

Centennial of First Transatlantic Voyage by a Steamship.—The first steam vessel to cross the Atlantic was the American-built vessel *Savannah*. This historical voyage was begun on May 22, 1819, from Savannah, Ga., and ended at Liverpool, the time required for the voyage being just twenty-five days. The vessel was of 350 tons, fitted out as a sailing vessel, but with arrangements for the installation of a 90-horsepower steam engine driving two paddle wheels.

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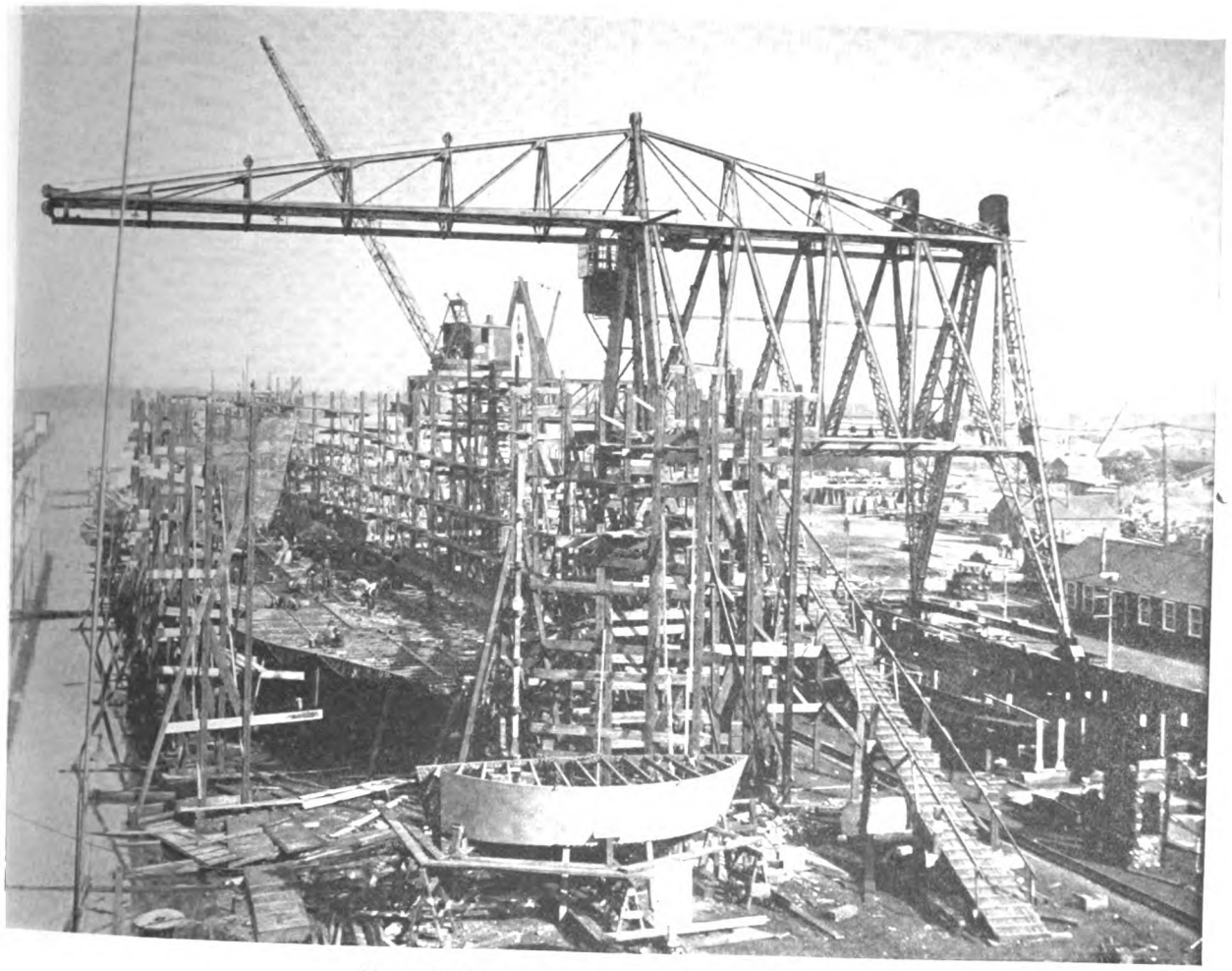

Fig. 1.—Gantry Erection Crane at Ecorse Yard

The Great Lakes Engineering Works

Detroit Company Which Operates Two Shipyards and Large Engine Building Plant—Output in 1918 Nearly 120,000 Deadweight Tons

SHORTLY after Charles M. Schwab was appointed Director-General of the Emergency Fleet Corporation he called together all the shipbuilders on the Great Lakes and told them that the Great Lakes shipyards must turn out a million tons of shipping during the next year—more than double the amount which they had produced in any previous year. Negotiations for carrying out this work at first were difficult, but the spirit with which these difficulties were overcome is shown by the prompt response of Antonio C. Pessano, head of the Great Lakes Engineering Works, who said: "Mr. Schwab, we, with our works and with all the influence I can exert, will do any work that you ask us to do that is within our ability to do, and you shall fix the prices and conditions of the contract." It was this patriotic spirit and loyal leadership that promptly rallied all the shipbuilders to affirm Mr. Pessano's statement and thus enabled the shipbuilders on the Great Lakes to contribute nearly one-fourth of the sea-going tonnage produced in the United States in 1918.

How well Mr. Pessano's pledges were fulfilled is shown by the fact that in 1918 the Great Lakes Engineering Works alone delivered to the Shipping Board no less than thirty-four steel vessels aggregating 118,800 deadweight tons—an output that represented the delivery of a completed ship at the average of one every nine working days of the year. At the end of 1918 the company was ahead of its contract schedule. Further than this, the company attained a world's record in speed of ship construction by building a 3,500-ton cargo steamer, the *Crawl Keys*, in twenty-nine days after the keel was laid.

The Great Lakes Engineering Works, whose main offices are in Detroit, Mich., has two shipyards, one in Ecorse, Mich., and the other at Ashtabula, Ohio, and a large engine building plant in Detroit. The output of the two yards in 1916, 1917 and 1918 and the schedule for deliveries in 1919 are shown in the following table:

Year	Ecorse		Ashtabula		Total	
	No.	Tonnage	No.	Tonnage	No.	Tonnage
1916	8	36,400	3	12,600	11	49,000
1917	8	59,100	3	20,400	11	79,500
1918	24	84,800	10	34,000	34	118,800
1919	29	119,400	15	61,800	44	181 200

To secure the increased output demanded during the war, the shipway capacity at the Ecorse yard was increased by a third and the crane capacity at the ways more

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than doubled. A new fitting-out berth with the necessary crane equipment was also added to this yard, greatly increasing the facilities. At the Ashtabula yard, where in 1916 there were only two building berths served by a single gantry crane, another building berth and another crane have been added, while still another building berth will be available this year.

Plans of the two yards are shown in the illustrations with this article. The Ecorse yard was built in 1903 and its first keel laid in January, 1904. The Ashtabula yard was built in 1911 and its first keel laid in October of that year. The first property purchased by the Great Lakes Engineering Works, when the present company was formed in 1902, was the Hodge Marine Engine Plant in Detroit, which is now the Rivard street engine building plant of the company and comprises a machine shop 240 feet by 82 feet, a foundry 312 feet by 86 feet, and an erecting shop 110 feet by 60 feet, besides a blacksmith shop, pattern shop and pattern storage building. This plant is fully equipped for building not only the propelling machinery but also many of the auxiliaries for all types of steam vessels. The machine and erecting shops are equipped with 35-ton overhead electric traveling cranes.

The Ecorse shipyard, which occupies a site about 65 acres on the Detroit River, has eight building berths located along the sides of two slips, one of which is 820 feet long by 150 feet wide, and the other 800 feet long by 109 feet wide. A third slip, over 2,000 feet long and 240 feet wide, at one side of the yard is used as a fitting-out basin. There is also a steel sectional floating dry dock at this plant, 785 feet long overall and 107 feet wide outside the wings.

Material is handled at the building berths by eight erection cranes. Three are gantries with a lifting capacity of 7 tons over the centerline of the ships and 3 tons at the outer ends of the arms, which have a reach of 80 feet.

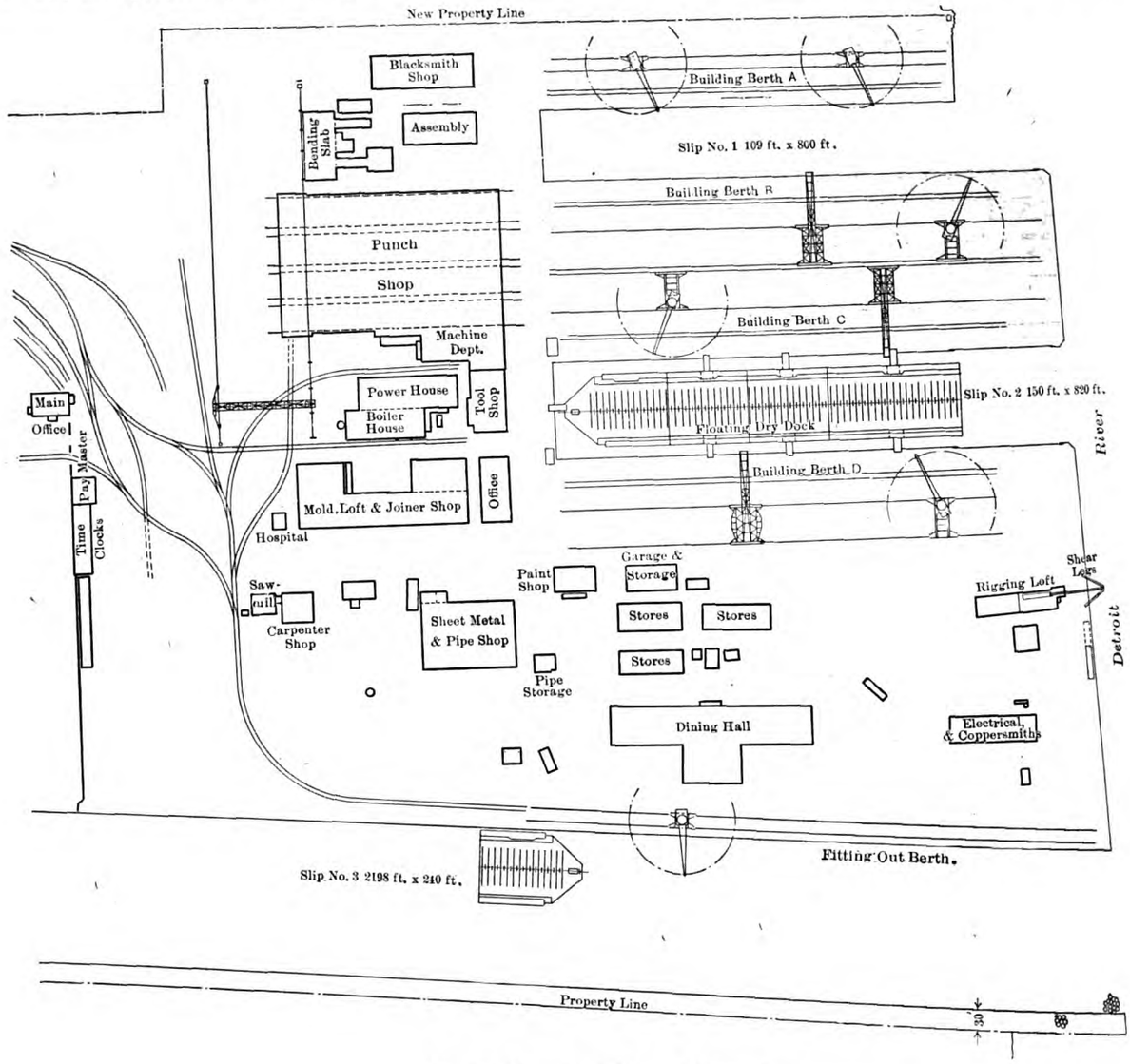

Fig. 2.—Plan of the Ecorse Shipyard

The other cranes are of the locomotive type mounted on traveling towers 44 feet high and with a reach of 76 feet from the inner rail. At the fitting-out berth, heavy weights are handled by a set of 100-ton sheer legs, and the lighter weights by a 15-ton locomotive crane with a maximum reach of 76 feet. For handling material throughout the yard there are six steam-driven, oil-burning locomotive cranes.

At the head of the building ways are grouped the principal fabricating shops. The storage yard in the rear of the plate shop is served by a 5-ton electric traveling crane, and the craneways in each bay of the plate shop extend

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40 feet beyond the building at each end, so that material can be conveyed from the storage yard through the shop to the shipway cranes. Oil fuel is burned at the bending slab furnaces and also at the rivet furnaces and in the heating furnaces in the blacksmith shop.

The power plant contains four vertical compressors of 3,000 cubic feet capacity each and two horizontal compressors of 2,500 cubic feet capacity each. Steam is provided for heating the offices, joiner and machine shops and the mold loft.

Among the new buildings are an office for the auditing department at the gate and a dining hall 315 by 60 feet, which has accommodations for 1,500 persons at one sitting. The kitchen is in an extension 90 by 60 feet. At present about 4,000 are employed at the Ecorse yard, or about twice the number on the payroll two years ago.

At the Ashtabula yard, which is located on the Ashtabula River, the building berths, served by locomotive type cranes, are placed end to end alongside a slip at one side of the yard. The fabricating shops are conveniently located adjacent to the ways, and the material passes directly from the storage yard in the rear through the shops and onto the ways. The plate shop, 310 feet long by 60 feet wide, is divided into two bays, each served by two 5-ton cranes. Outside the plate shop is an assembly space served by a 5-ton crane.

Facilities for repair work are provided at this yard, including a graving dry dock 650 feet long and 72 feet wide with a depth of water over the sill of 16 feet. Alongside the dry dock is a fitting-out slip. A locomotive type crane, which is a duplicate of the one at the fitting-out berth at the Ecorse yard, serves both the fitting-out slip and the dry dock. For lifting heavy weights, a set of 75-ton sheer legs is provided.

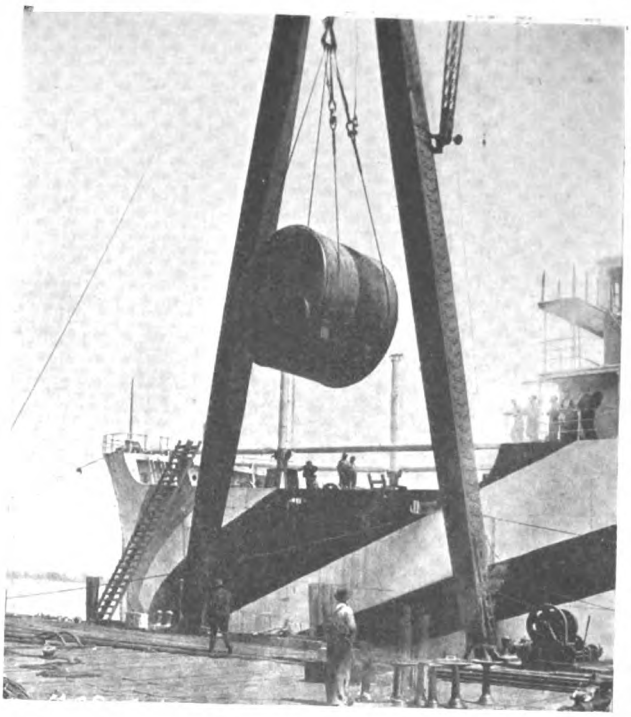

Fig. 4.—Sheer Legs at Fitting-Out Berth

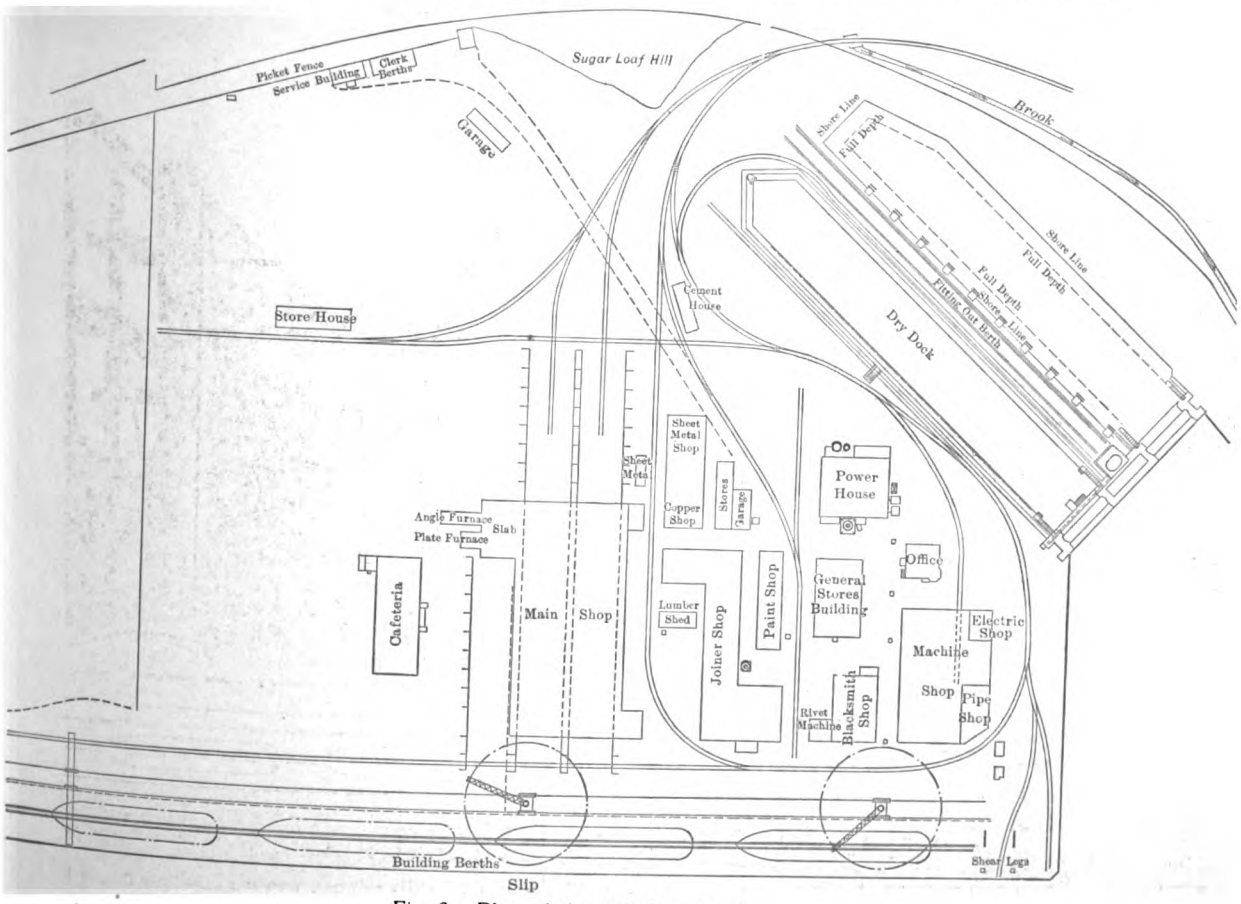

Fig. 3.—Plan of the Ashtabula Yard

The power plant includes one vertical air compressor of 3,000 cubic feet capacity and two horizontal compressors of 2,500 cubic feet capacity each. Gas is burned as fuel in the power house and in the furnaces at the bending slab.

About 1,700 workers are employed at the Ashtabula yard, or about twice the number employed two years ago.

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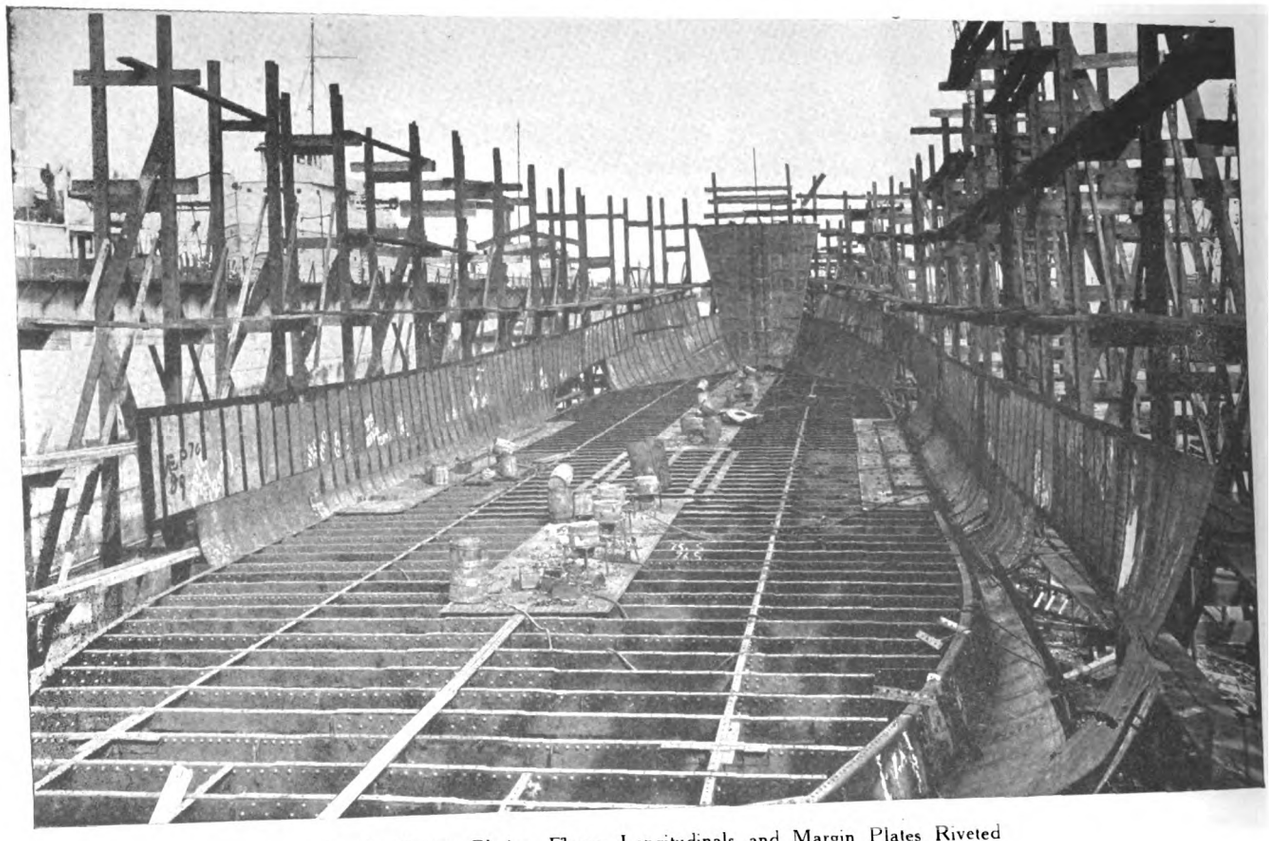

Fig. 5.—Bottom Plating, Floors, Longitudinals and Margin Plates Riveted

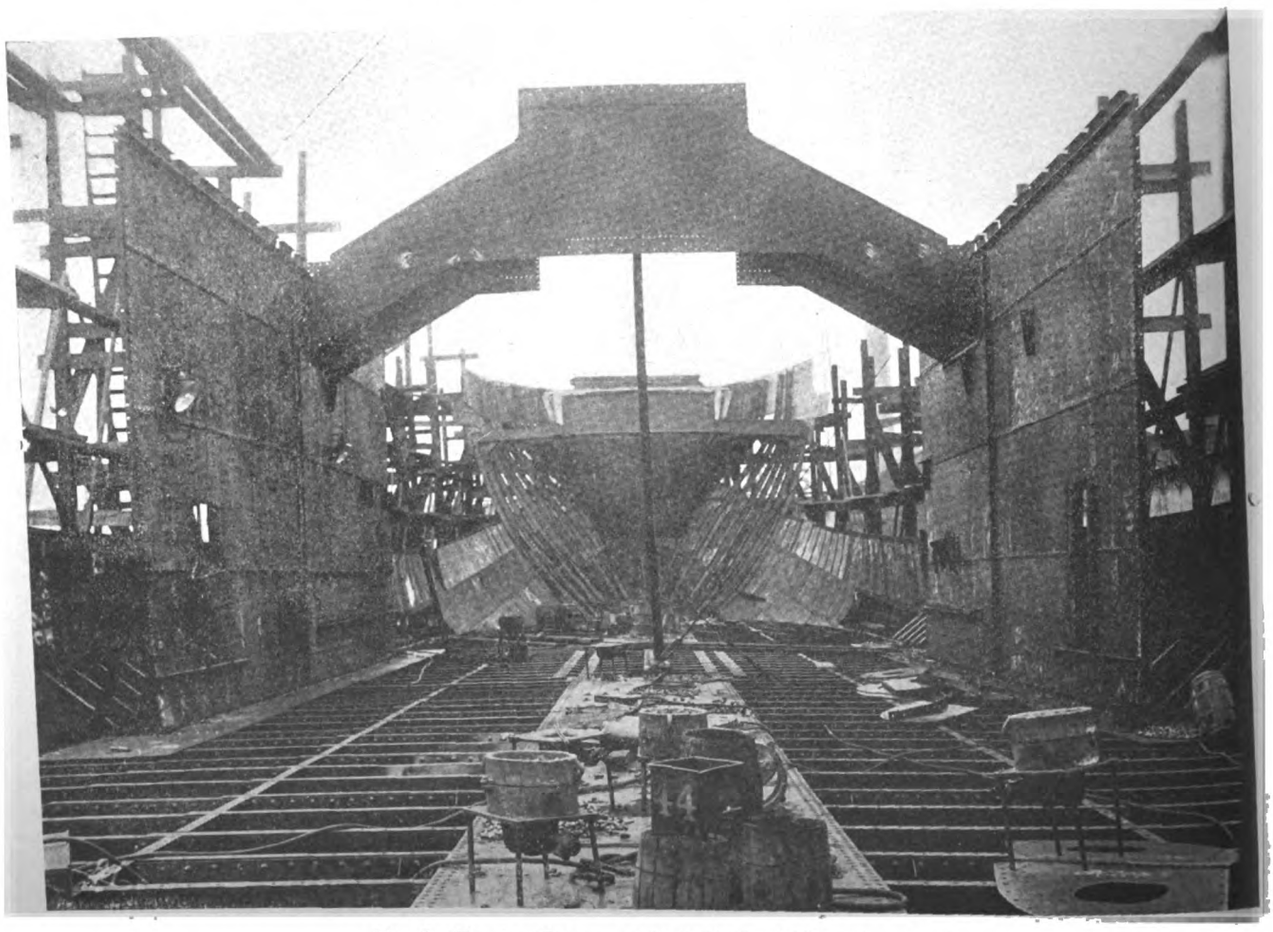

Fig. 6.—Framing Begun and Coal Bunker Bulkheads Erected

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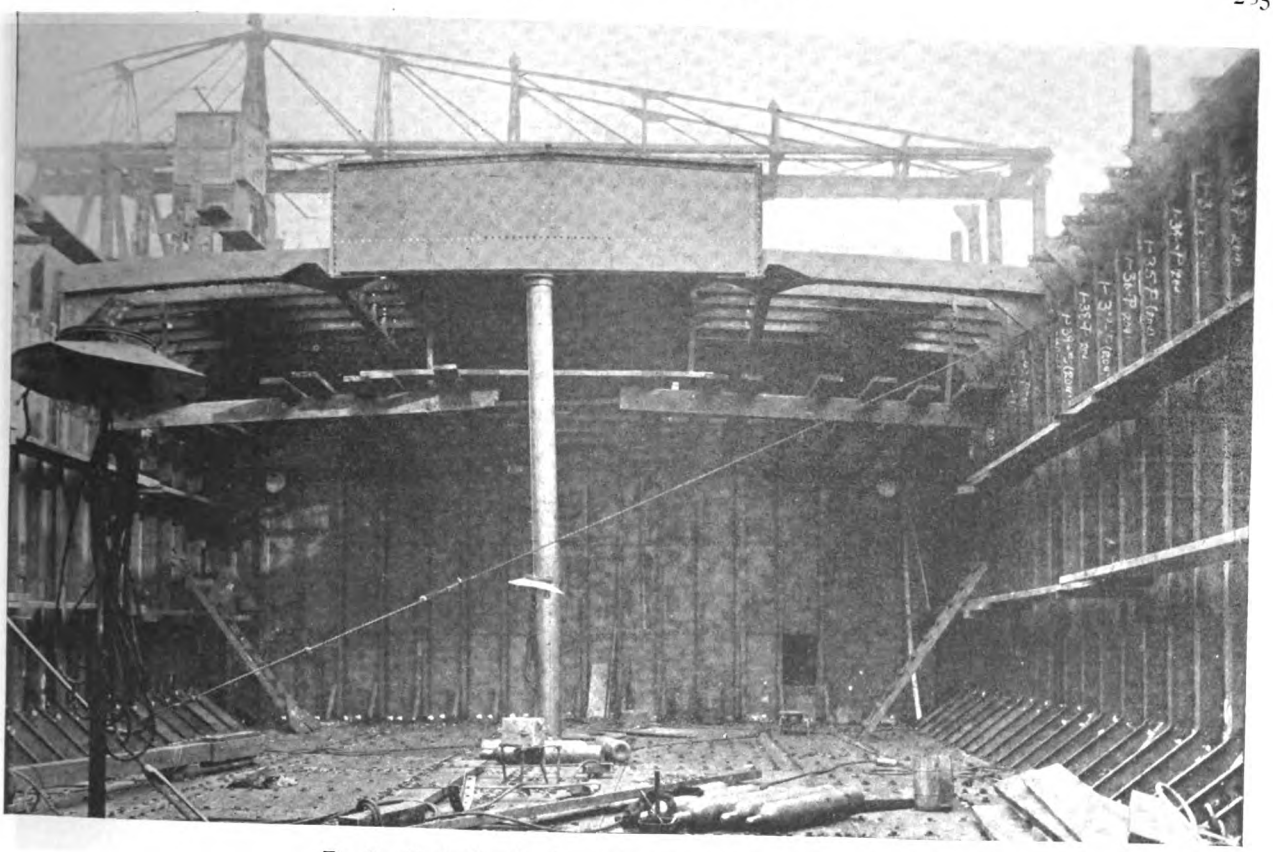

Fig. 7.—Tank Top Laid and Transverse Bulkheads in Place

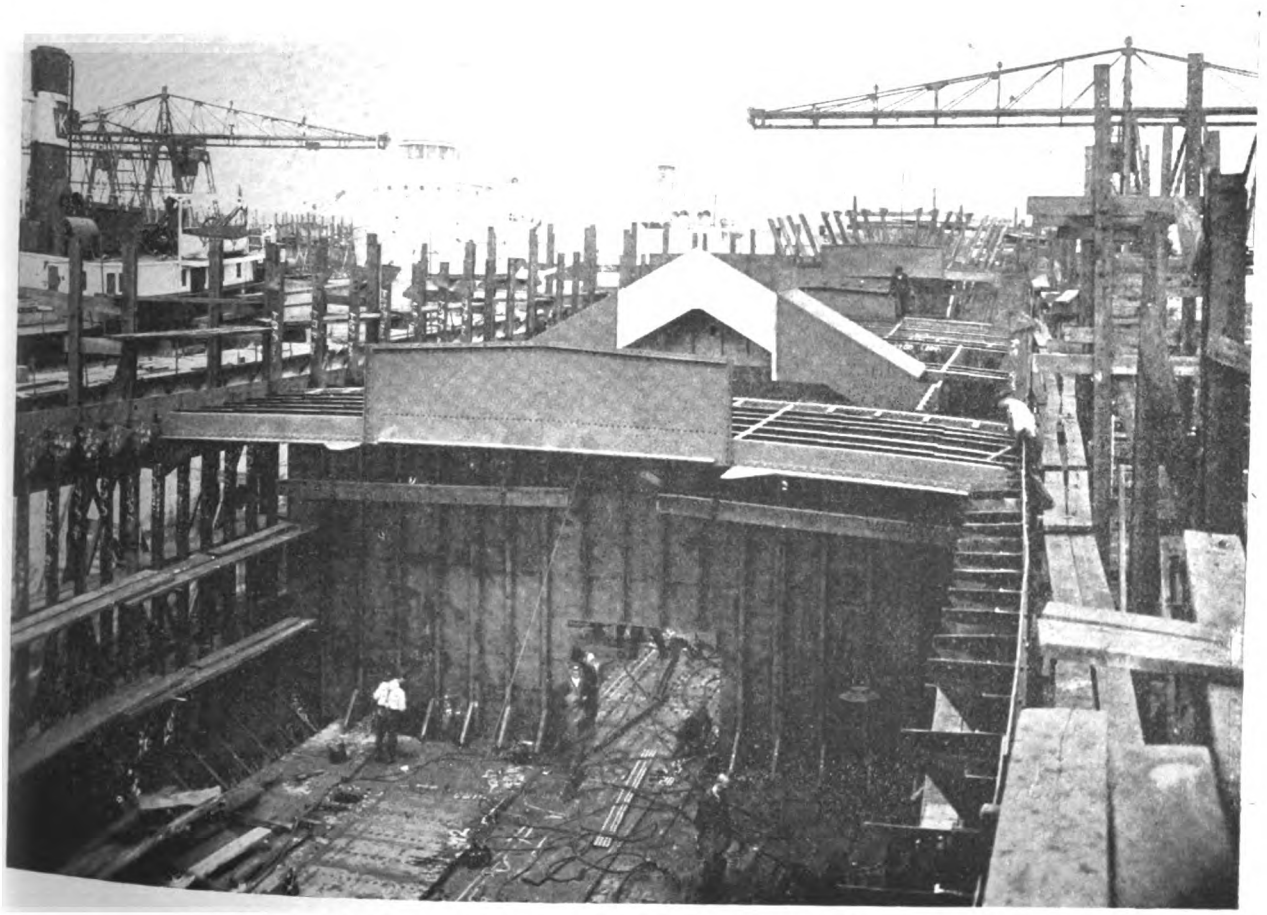

Fig. 8.—Side Plating and Deck Beams Being Bolted Up

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Fig. 9.—Laying the Deck Plating and Erecting Hatch Coamings

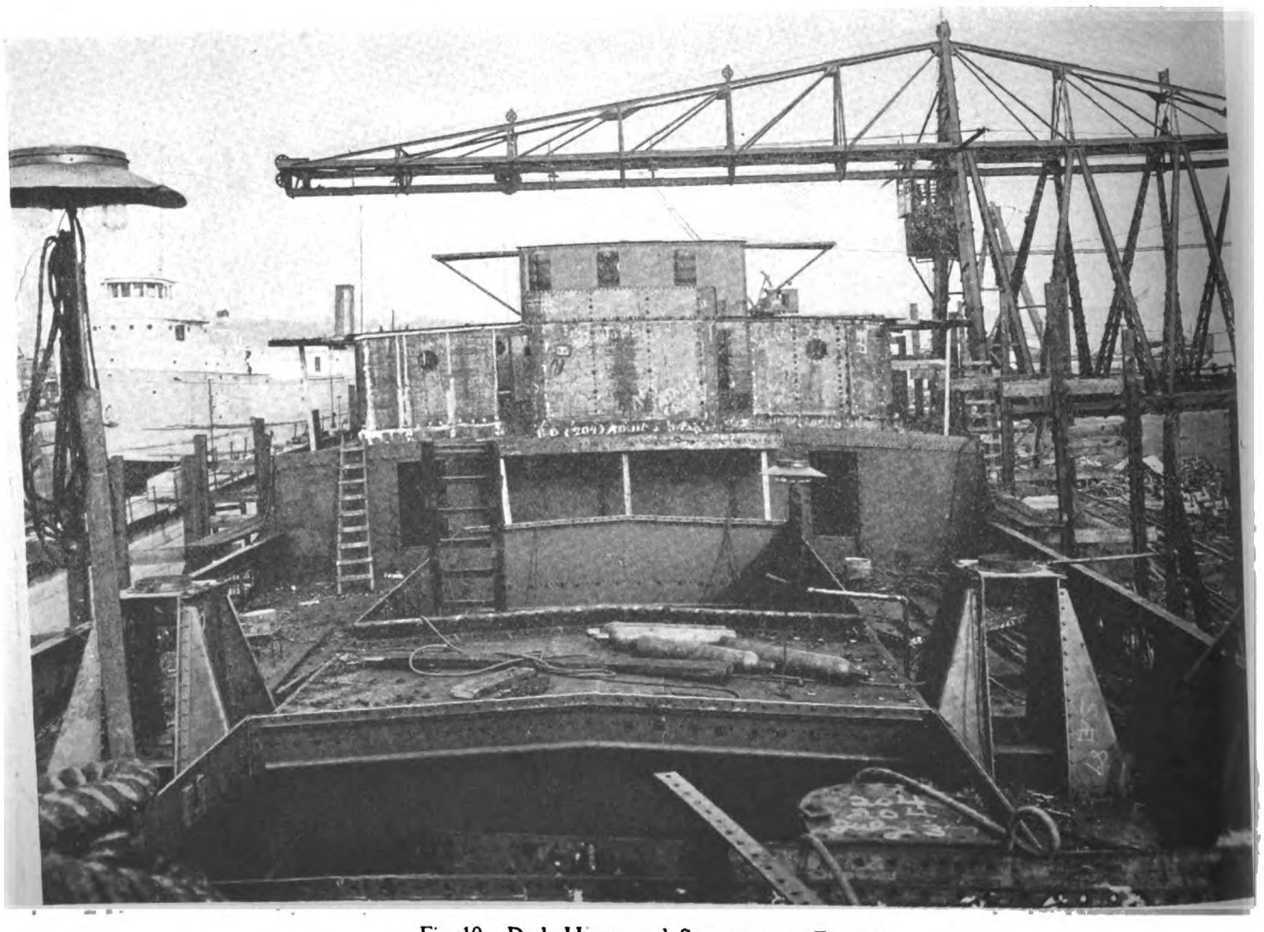

Fig. 10.—Deck Houses and Superstructure Erected

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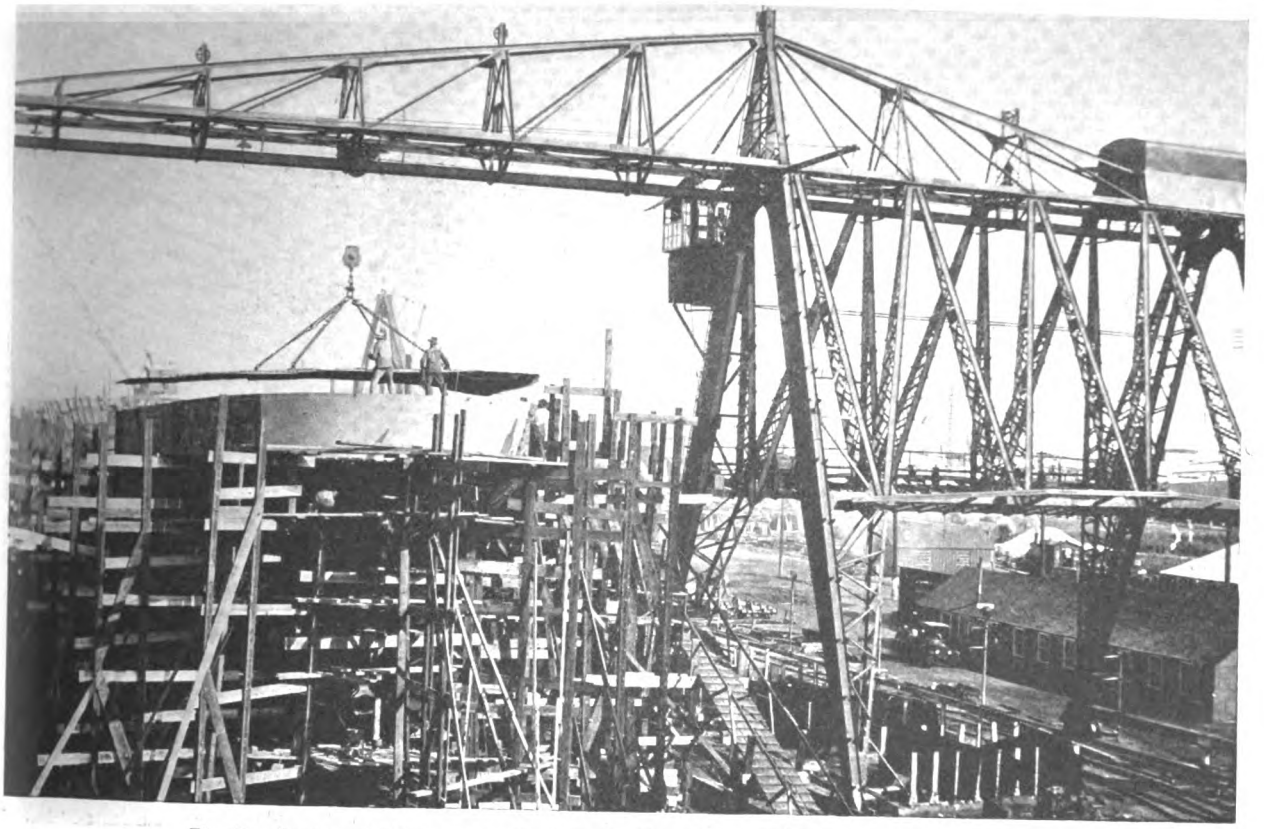

Fig. 11.—Section of Plating Assembled on the Ground Hoisted Into Place by Gantries

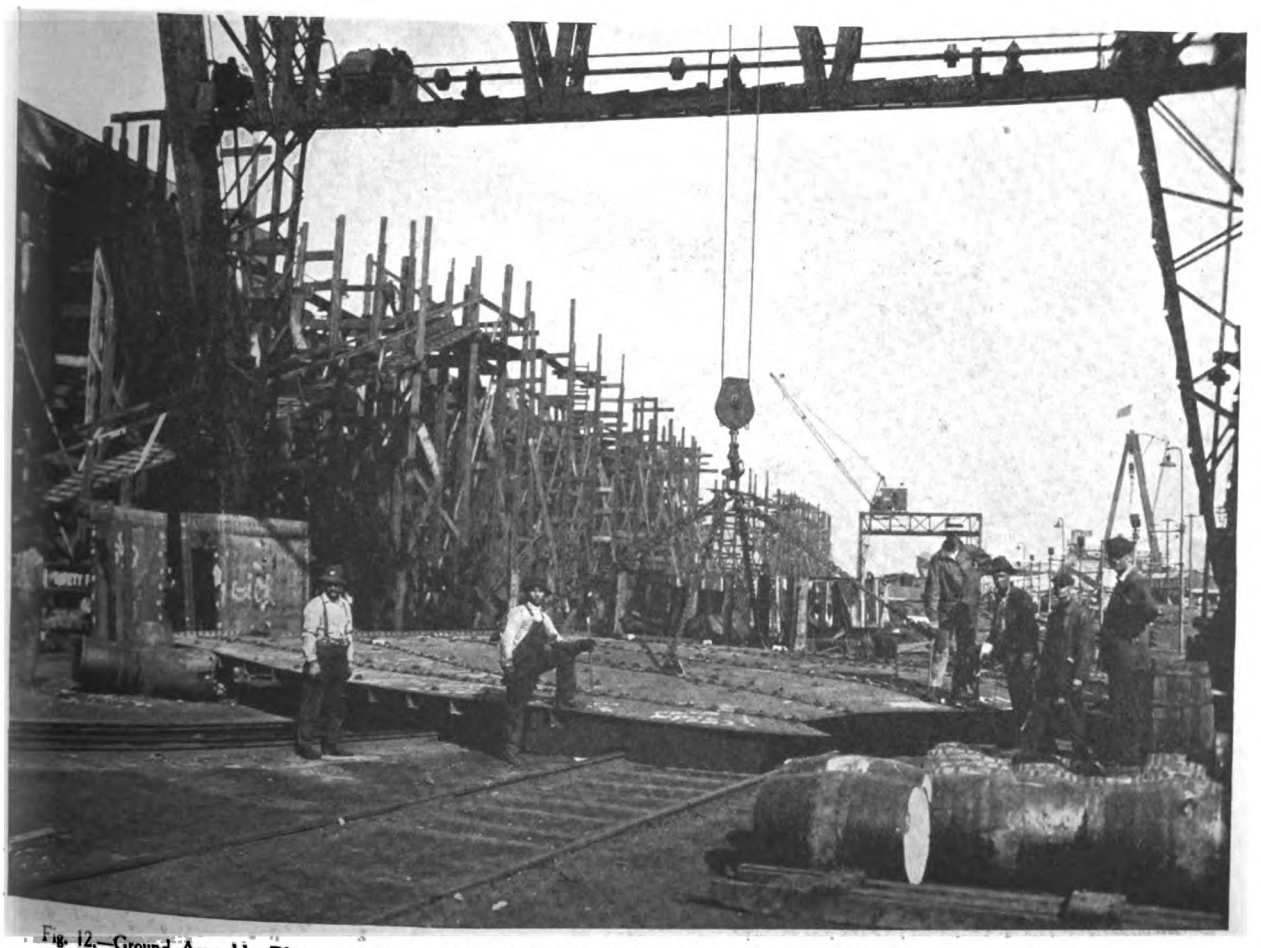

Fig. 12.—Ground Assembly Plays an Important Part in Rapid Construction at the Great Lakes Engineering Works Yards

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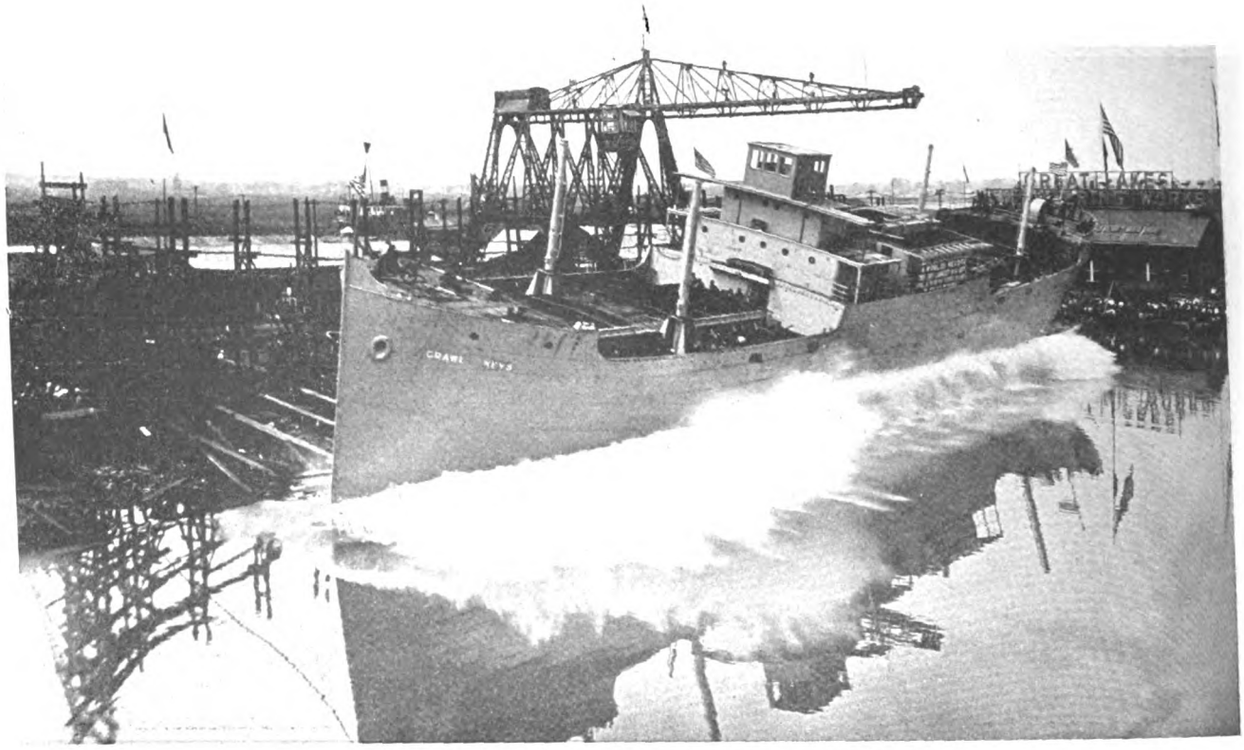

Fig. 13.—Launching the *Crawl Keys* 14 Days After Laying the Keel

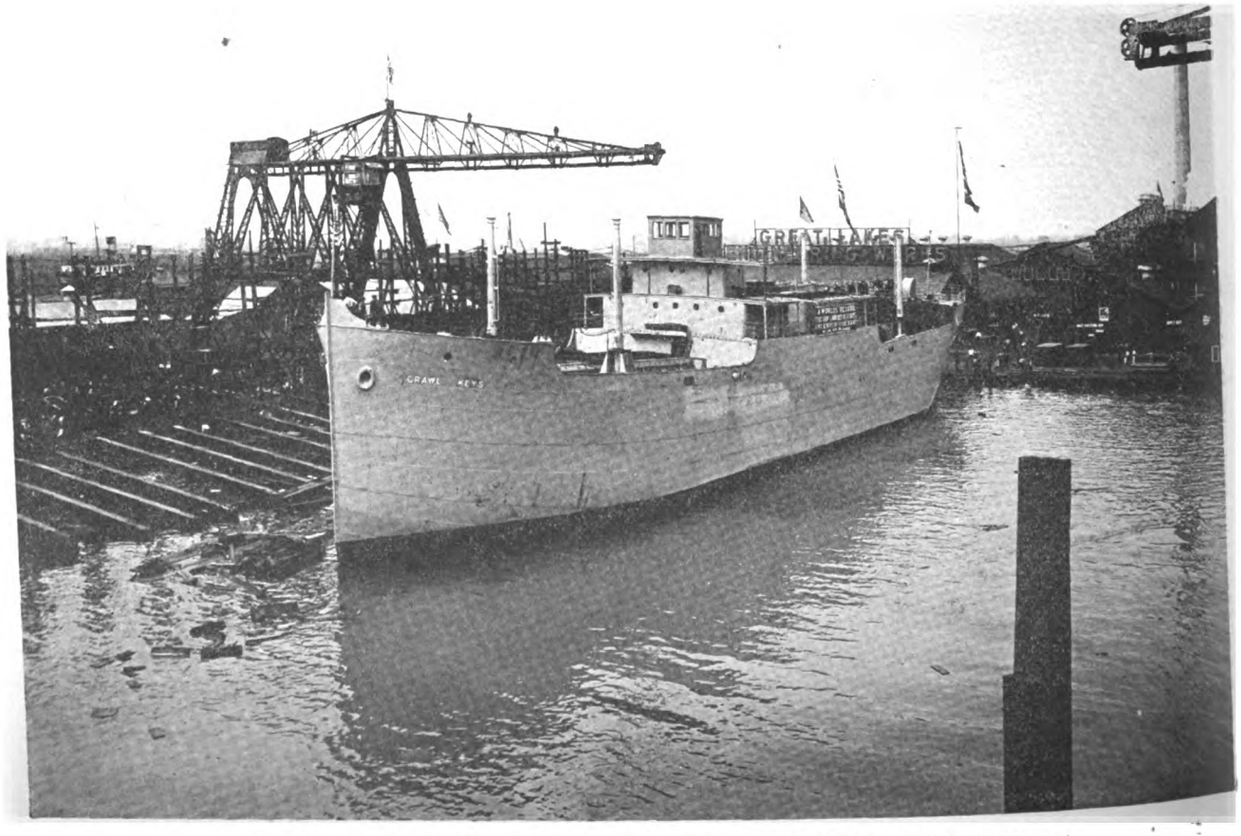

Fig. 14.—S. S. *Crawl Keys* After Launching. The Vessel Was Completed in 29 Days

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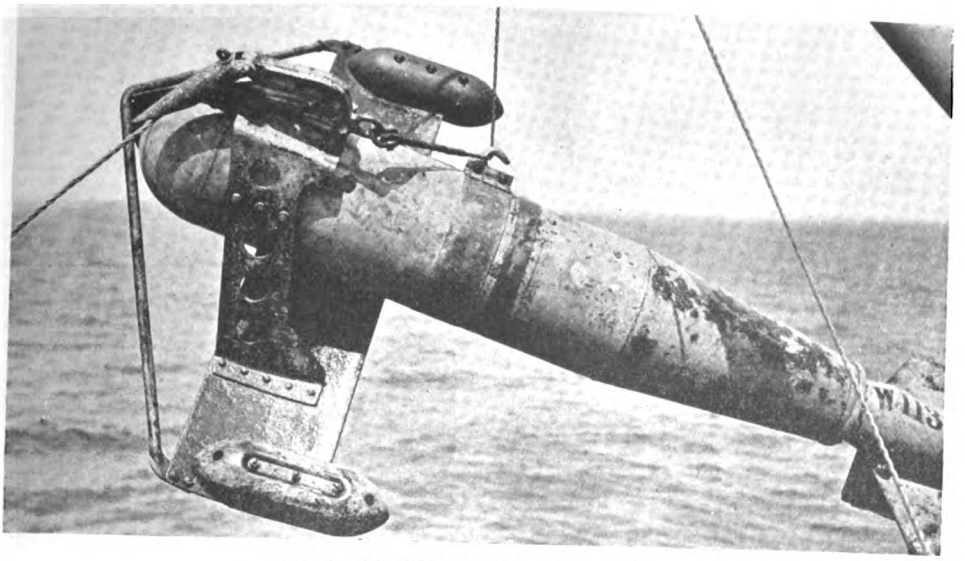

Fig. 1.—The Paravane Rigged for Action

The Mysterious Paravane

The Invention That Countered the German Mine and Saved Many an Allied Vessel from Destruction

BY WILLIAM WASHBURN NUTTING

MANY of the clever devices produced under the stimulus of war are already pretty generally known. Others are not known at all, or else exist merely as names in a strange, new war vocabulary. The tank, for instance, has become a household word, while the paravane, which shares with it the distinction of being the most important of the war's big crop of inventions, is practically unknown.

The paravane or "P.V." or "otter," as it is variously known in the nomenclature of the Allied navies, is the thing that foiled the German mine. Nearly four thousand vessels were equipped with the gear by the British alone, and of this vast number there is no record of the destruction of a single ship by a moored mine. Several hundred American vessels were equipped before the signing of the armistice, and the programme was to have included practically every ship of the Navy and merchant marine. This would have meant an expenditure of ten million dollars (£2,050,000). In saving one of our first-class battleships from destruction, however, the paravane justified itself and the ten million in one stroke.

That some new device had been perfected which permitted Allied ships to traverse mine fields, theoretically deadly, with impunity has long been guessed, but the jealous care with which the secret was guarded kept the details of the gear from the Germans to the last. Many and varied were the explanations of certain odd devices rigged on the bows of an ever-increasing number of naval and merchant vessels, and ludicrous indeed were the stories of the strange winged torpedoes which were likewise carried. This, we believe, is the first time that an authentic description of the device has been published, except in the leaded confidential books of the Navy.

Paravanes and the gear for handling them were perfected during the first two years of the war at the dock yard at Portsmouth, England, and in some quarters they are still known as the Burney gears, after Commander Burney of the British Navy, the inventor. The primary object of the paravane is the protection of ships against moored mines, although there is another type, the mysterious and deadly "Q," which is explosive and which was used with telling results against the submarine. But the protective type is by far the more important. This type is divided into three subdivisions, according to the speed of the vessel on which it is used.

How the Paravane Works

A glance at the diagram will give an idea of how the gear works. A pair of the otters, which act on the same principle as kites, is towed from the forefoot of the vessel. These stand well out, forming, with their tough steel towing ropes, a huge wedge. The length of these towing ropes varies somewhat with the length of the vessel, but is, roughly, in the neighborhood of 150 feet. These wires encounter the mooring wire of the mine and deflect the mine, and frequently its mooring as well, clear of the vessel, the mine wire sliding out along the towing rope and into the cutter head of the paravane, where it is severed by serrated steel knives. When the mine rises to surface it is exploded or sunk by gun fire or reported to a patrol vessel.

The body of the otter, which is of steel, is much the same shape as a torpedo, although somewhat shorter. It is watertight and has a positive buoyancy of about ninety pounds, which is sufficient to support half the weight of its towing wire and still bring it to the surface in case the ship stops. A large steel plane, cambered like the wings of an aeroplane, is attached as shown in the illustrations. When the otter is in action, this plane assumes a vertical position, pulling the paravane out away from the ship and exerting sufficient tension on the towing rope to deflect the mine. It will be noticed that there are two bulbs on the ends of the plane. One of these is a loaded steel shell, which gives the otter the proper list to cause it to assume quickly its normal position, even when starting from rest.

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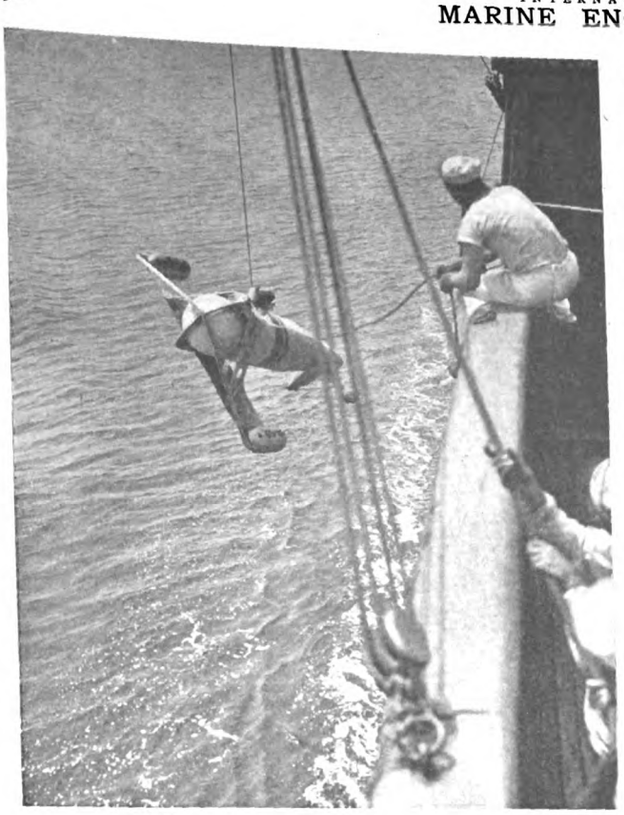

Fig. 2.—Swinging the Paravane Over-Sides

The other is a wooden duplicate of the first, placed there not so much for buoyancy as to make the structure symmetrical and to equalize the steering effect, which would be thrown out of line if the shell alone were used.

Device to Hold Paravane at a Constant Depth

In order to be sure of picking up the mine, which is ordinarily moored a couple of fathoms beneath the surface, the paravane must be made to run at a constant depth. This is accomplished by means of a horizontal rudder in the tail, operated by a hydrostatic valve placed in the joint between the tail and the body of the otter. The water pressure acting on the after face of a rubber diaphragm is backed up by a spring on the inside; the compression of this spring may be regulated to cause the otter to maintain any desired depth. When the otter dives, the increased water pressure drives the diaphragm forward, and this motion is transferred to the rudder through a valve stem and a tiller, giving it uphelm. When the otter rises above its set depth, the water pressure falls off and the spring drives the diaphragm aft, imparting downhelm to the rudder. Consequently it will be seen that the otter cannot maintain an absolutely constant depth, but must oscillate a bit above and below the average line. It will be seen, too, that this oscillation, or "porpoising," will increase with the speed at which the otter is towed, for the reason that the greater the speed the farther will the paravane rise or sink before the hydrostatic valve has a chance to act upon the rudder.

The Action of the Mercury Oscillator

This excessive porpoising at high speeds prevents the use of the simple type of paravane just described on ships of greater speed than sixteen knots, but this, of course, would include the great majority of merchant vessels. For use on ships of greater speed, such as liners, battleships, cruisers, and the like, it was necessary to equip the otter with some sort of stabilizing device which would perform the same function as the pendulum in a torpedo. The device used—called a "mercury oscillator"—is a 6-foot tube of mercury with a diaphragm at either end through which the valve stem of the hydrostatic valve extends. This tube occupies a position between the spring and the diaphragm of the hydrostatic valve. Its own diaphragms are attached to the valve stem, imparting their effect with that of the spring and the water diaphragm.

As soon as the otter starts to dive or to rise, the head of mercury thus created causes a pressure on one or the other of the diaphragms, which, in turn, transfers it to the valve steam and thence to the rudder. This device is merely an addition to the hydrostatic valve, which works, as in the slower types, to keep the otter at approximately the right depth. The oscillator merely prevents porpoising and permits the towing of the otter at high speed. Two types are equipped with the oscillator, one for extreme speeds, such as would be attained by the destroyers and battle cruisers, and the other for intermediate speeds, such as are attained by battleships.

Towing Devices

It is obvious that, in order to protect the ship thoroughly, the otter must run at a depth not less than the draft of the vessel and that the towing point at the stem must be as low as possible. Mines are ordinarily moored a couple of fathoms below the surface. If a vessel were pitching, however, it might go over a mine unless the point of attachment of the wires was placed low. It is obvious, likewise, that the point of tow must be as far forward as possible in order not to leave any considerable portion of the bow unprotected.

The Sliding Shoe

To get the towing point as near as possible to the intersection of the stem and keel line was a problem. On ships with a deep forefoot, that is, ships which are not cut away

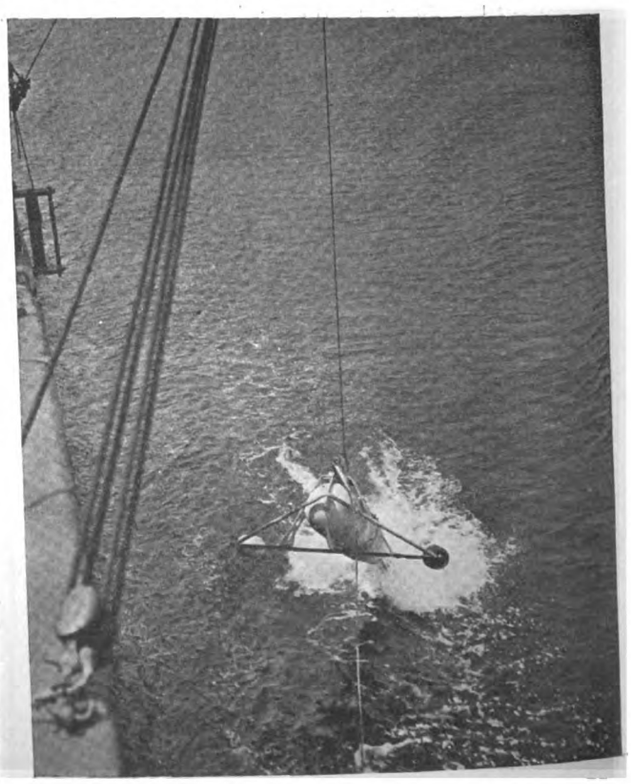

Fig. 3.—Launching the Paravane

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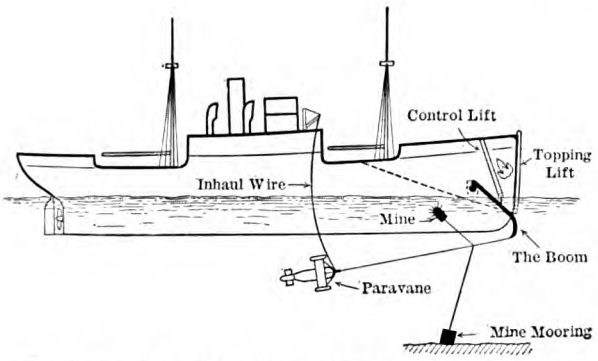

Fig. 4.—Operation of the Paravane When Towing Rope Is Held by a Boom

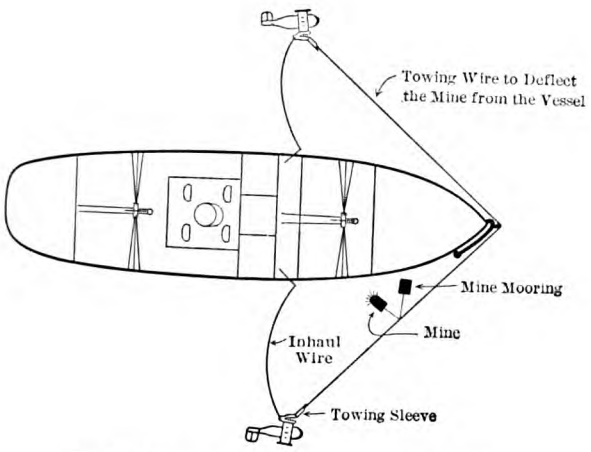

Fig. 5.—Diagram Showing Action of Paravanes

much below the water forward, it was simple enough to lower a horseshoe-shaped forging, with the towing wires made fast to either arm, down the stem. All the gear needed was a topping lift and a couple of backhauls to hold the "sliding shoe," as it was called, in place.

This was the method used on all the new vessels of the Emergency Fleet Corporation, since it was an easy matter to build out the forefoot with a "stem extension" while the vessel was under construction. But it would have been necessary to have equipped hundreds of vessels of all types—naval vessels as well as those of the merchant marine—(and most ships, especially large, high-speed vessels, are cut away to too great an extent to permit the use of the sliding shoe)—since it would not have been practicable to build in the entire cut away portion with a skeg. And so two other towing devices were perfected, one called the "boom" type, for slow merchant ships, and the other called the "clump and chains," for naval vessels and the larger, faster ships.

The Boom

Since the boom is an unwieldy piece of furniture, weighing in the neighborhood of a couple of tons, it was only used on the slower types of freighters. It is a built-up affair of forgings connected by a length of pipe and is trunnioned on the starboard side of the ship somewhat abaft the stem and a little above the waterline. The boom is so shaped that when lowered the towing point comes directly under the forefoot. A large clip on the boom engages the stem, holding it in position.

Theoretically, this arrangement is good. It is not a pleasant thing, however, to handle in a seaway and requires a lot of gear—a topping lift over the stem head, with which the boom is raised; a control lift by which it is swung around to the rail, where it is secured with chains when not in use, and a backhaul extending from the clip to a point aft on the port side. This backhaul is used to guide the boom and prevent its slatting about while it is being lowered.

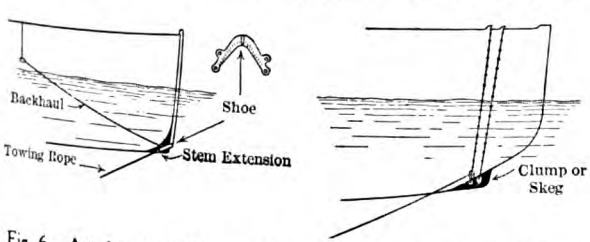

Fig. 6.—Attachment of Towing Rope with Shoe and Clump Devices

The Clump and Chain

On large, fast vessels it is impossible to get the towing point exactly where it should be. The forefoot is usually cut away, prohibiting the use of the sliding shoe, and a boom of the size which would be required would be out of the question. So a skeg, or "clump," is built onto the keel as low as possible without cutting the base line. Through two large holes in this skeg two chains are rove, extending from one rail to the other. These chains are run over the bow chocks and each carries a "dumbbell" and swivel link, to which one of the towing wires is attached. The towing points are lowered by hauling in on the other ends of the chains. By attaching the ends of the chains to a single tailing wire, they may be lowered simultaneously without difficulty.

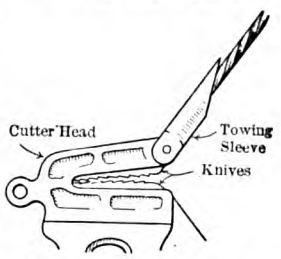

Fig. 7.—Detail of Cutting Device

The position of this skeg or clump is important. In order to prevent the possibility of the towing wires going over the mine, allowing it to come into contact with the bottom of the vessel, the skeg must be low down. This means that unless a very large skeg is used, it must be considerably aft of the stem. The placing of the skeg, therefore, is a compromise, for, when in the position just mentioned, it leaves a considerable section of the bow unprotected. But this is not so dangerous as it might at first seem, since it has been found by experiment that a mine is rarely encountered directly on the stem, or, in fact, within several feet of it. The action of the displaced water tends to throw it well to one side or the other, and the towing rope picks it up before it has a chance to strike the ship.

But let us assume that the ship did pick up a mine dead on the stem. The chances are that even in such a case it would not be greatly damaged if equipped with this gear. This is the reason: The German mine, the one with the horns, is so designed that it does not explode at the instant of contact. When a horn is bent or broken, in turn breaking the glass vial of acid which it contains, the action of the latter is not instantaneous. There is a delay of several seconds, the purpose of which is to cause the mine to explode well along the side of the vessel abreast the engine room or at some spot more vital than forward of the collision bulkhead. In such a case the towing wire would pick it up and deflect it well clear of the ship before it exploded, and the chances of serious damage would be slight.

But we need not depend entirely on theory to back us up

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in this statement. Over four thousand vessels have been equipped with the otter gear, and of that great number there is no record of the destruction of a single ship by a mine, although it is definitely established that many a vessel has been saved by the gear.

LAUNCHING THE OTTERS

The otters were used—and, in fact, are still used—in all waters less than a hundred fathoms deep where mines are likely to be moored. When the hundred fathom curve is reached the towing wires are bent onto whatever towing device is used and the latter is lowered away. The towing wire is draped over a hook at the rail, called the "easing-out hook," and is held by some sort of a "stopper" to prevent the bight of wire, which is dragging in the water, from pulling the rest of the wire taut and interfering with the launching of the paravane.

When this is done the paravane is swung out on a specially provided crane by means of a second wire called the inhaul wire, which is permanently attached to the otter and drags through the water. This wire is led through a hook, as shown, in order that the otter may strike the water more nearly in its normal running position, allowing it to be launched at much greater speed. When the paravane is out over the water, the stopper, mentioned above, is cast off and the paravane is dropped. There is a tendency for the otter to dive when it is first launched, and for this reason it is allowed to tow from the easing-out hook at the rail until it has found its depth and is running steadily. Then the hook is paid out and tripped, releasing the towing wire and allowing the otter to find its position a hundred feet or more from the side of the ship.

Many ludicrous statements about the paravane have appeared recently, which only go to prove how remarkable was the secrecy with which the device was guarded throughout the war. A popular misconception is that the otter is self-propelled, the current being conveyed through a wire. Another is that the mine wire is sheared off by means of some mechanical device. The jaws in general use are stationary and contain a pair of tool steel knives with saw teeth, set at a very small angle, so that a comparatively slight pull will sever the wire cable. Any rope that will enter the jaws is cut instantly. Even 5/8-inch wire, which is much heavier than could be used on any existing type of mine, has been cut with no apparent difficulty.

THE SIZE OF THE PROGRAMMES

As we have said, the Admiralty equipped in the neighborhood of four thousand vessels of all types with the otter gear, and there is no question but that this vast programme paid for itself over and over again in the vessels which were saved from damage or destruction. Soon after the United States joined forces with the Allies, an arrangement was made with the Admiralty to permit the building of the gear in this country, and up to the time of the armistice several hundred vessels of the Navy and Emergency Fleet Corporation had been equipped.

The paravane was a strange, new device to our people and was pretty generally looked upon with skepticism until its worth actually had been demonstrated. For the purpose of demonstration, and for the instruction of officers in the handling of the gear, a vessel was completely equipped and placed in commission in New York waters. She was provided with a lecture room, equipped with a motion picture machine, and worked in conjunction with a mine layer, which each day laid a couple of dummy mines for her to cut.

A vessel was, or rather still is, engaged in the testing of paravanes after they come from the factory, for those vessels already fitted are still using their paravanes, and in all probability will continue to do so until all danger of mines has been removed.

Suggestion for Building Up the American Merchant Marine

BY WILLIAM T. BONNER

If our Government is disposed to lend its capital and credit to the development of our merchant marine, it may do so by aiding private corporations to take over the entire emergency fleet and at the same time advance our commercial relations throughout the world by a very simple though extensive system somewhat as follows:

First.—Tranfer the Emergency Fleet and Shipping Board property holdings to private corporations at appraised prices.

Second.—Allow the purchasers to pay the contract amounts in ten annual instalments from earnings or capital, or both, full ownership to pass from the Government to purchasers only when payments are completed.

Third.—The Government to aid in the development of our foreign trade through the medium of a thoroughly reorganized consular service, which shall maintain a live commercial representative (non-political) in every important town in the world. Each representative should be fully informed regarding the country's resources and have a complete library of catalogues and statistics pertaining to our products of farm and factory. According to the prominence of his post, each consular agent should maintain a more or less extensive exhibit of the representative American articles of commerce adapted for use of consumption in his district.

Fourth.—The Government to plan and arrange for the maintenance of a schedule of regular sailings for American ships between each consular port and some well-selected American port, and contract with the operating company for a fixed amount of cargo space and passenger accommodation for each voyage.

Fifth.—These Government reservations to be placed at the disposition of the consular service for the free transportation of samples and exhibits outward, raw material consignments inbound, and for sending agents and commissions from the foreign consular districts to study our resources and purchase our products.

Sixth.—In addition to the consular cargo, the Government to institute a thoroughly efficient postal system somewhat similar to our railway mail service between each of its home and consular ports, which shall be an *all-American service.*

In the meantime, it is presumed a reasonably amended Seamen's Act shall have been passed, as there is little prospect that the United States will ever obtain, even temporarily, commercial supremacy of the seas under the conditions imposed by the LaFollette bill.

However active our merchant marine might be in the interest of the commercial consular service, it need not conflict with any proper Governmental function of our Navy. The training systems now conducted by the Navy might be enlarged upon for the preparation of our consular agents for their duties, as in no other way could prospective consuls secure such practical instruction and experience as that obtainable by direct contact with our naval operations. Moreover, a consular preparatory school of this sort would be closely akin to the school for diplomats which was recently proposed as an adjunct of our naval training system.

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Report of the Port and Harbor Facilities Commission of the United States Shipping Board For Twenty-Two American Ports

REVIEWED BY H. MCL. HARDING*

The data contained in this most valuable report, which was compiled by J. F. Lane, statistician of the Port and Harbor Facilities Commission, are capable of extensive practical application. For example, there is given the quantity of electricity available at each port for light and power, including the kind of current, direct and alternating, voltages, cycles, etc. Such facts are of service to all manufacturers of freight-handling machinery, to the port authorities and to terminal engineers preparing plans and designs for port development.

It is recognized by the commission that electric power will be extensively used for the mechanical movement of freight between the vessel and shore, and for the handling—that is, the assorting, distributing and tiering—of cargoes.

Taking, as an example, the report on Baltimore, which is summarized under many headings, the facts, with the exceptions noted below, are quite complete. The remarks concluding the statistics of this port contain statements of great worth—the mentioning of the fact that at the port of Baltimore most all the outbound freight is transferred directly from car to vessel, and other important points.

While a statement of the volume of tonnage transferred at each port, as well as the character of the freight, would have been comparatively useful, yet, with commerce in its present transitional state due to the increasing tonnage, such figures can better be given in a later supplementary report.

Baltimore is treated under the following headings: (1) Controlling depth of water to the sea; (2) Berthing capacity in linear feet, with list of piers and their areas in square feet; (3) Railway ownership and control of piers; (4) Names of railroad lines serving the port; (5) Dry-docking facilities; (6) Anchorage area available; (7) Fresh water; (8) Quantity and characteristics of electric current available; (9) Coaling facilities; (10) Fuel oil facilities; (11) Crane and derrick facilities; (12) Steamship lines; (13) Grain elevators; (14) Remarks.

As to the mechanical facilities for transferring and handling miscellaneous cargoes and package freight at the twenty-two ports covered in the report, there is practically none, although, in order that there may be items entered under this head, references are made to the privately owned facilities for bulk freight, lighter derricks and coal cranes.

The writer considers it essential that for waterborne foreign commerce, freight-handling facilities should be publicly owned. As the berthing frontages with their depths of water are given, it is possible to determine the immediate marine tonnage transferring possibilities.

It is hoped that Mr. Lane will continue these reports in relation to many other ports, as there is no doubt as to the necessity for the compilation of such information to assist in the development of the foreign commerce of the United States. Reference should be made to all ports where there is an opportunity for commercial port development, even though there is little commerce at present. Such a report would stimulate commerce.

An outline map of a plan of the physical characteristics of each port should be made a part of the complete report. The electrotypes of these plans would be readily furnished by the port authorities of the different cities.

*Consulting Engineer of the State of New York on Barge Canal Terminals.

Elevators on Mine-Laying Fleet Made Possible Steady Flow of Mines to Launching Deck

MUCH has been written and said lately about the remarkable feat of Mine Squadron One of our Atlantic Fleet in laying a barrier of mines 230 miles across the North Sea from the Orkneys to Norway. The squadron, under command of Captain R. R. Belknap, U. S. N., consisted of eight former merchant vessels converted for the special purpose of mine laying. The four vessels of the *Roanoke* class carried 860 mines each, the two of the

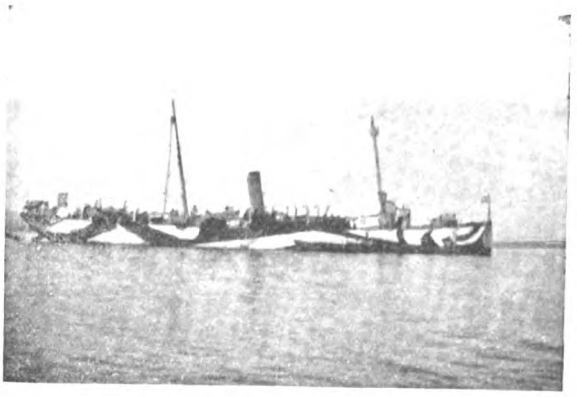

Fig. 1.—Mine-Laying Steamer *Roanoke*

Quinnebaug class 600, and the *Shawmut* and *Aroostook* 350 each, the latter all carried on one deck.

Storage of the Mines

The problem of efficiently carrying the mines from their storage in the two lower decks to the launching deck was solved by installing on all ships but the *Shawmut* and *Aroostook* a system of elevators, partly of the electric type and partly of the hydraulic type. This equipment was furnished by the Otis Elevator Company, New York, and proved to be highly successful in performing their chief function, that of keeping a steady flow of mines to the launching deck during the operation of planting the mines.

Of the six ships thus equipped, four, the *Roanoke*, *Canonicus*, *Housatonic* and *Canandaigua*, were furnished with six elevators each, and two, the *Quinnebaug* and

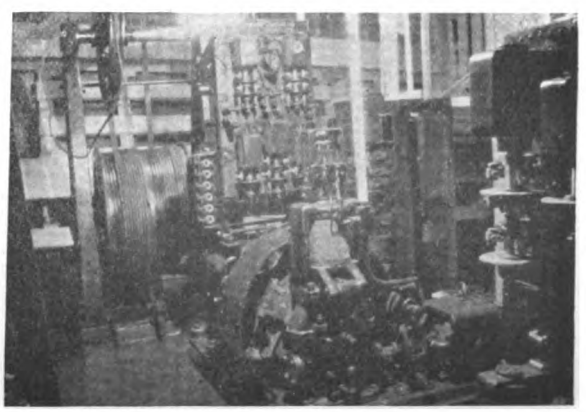

Fig. 2.—Elevator Machinery

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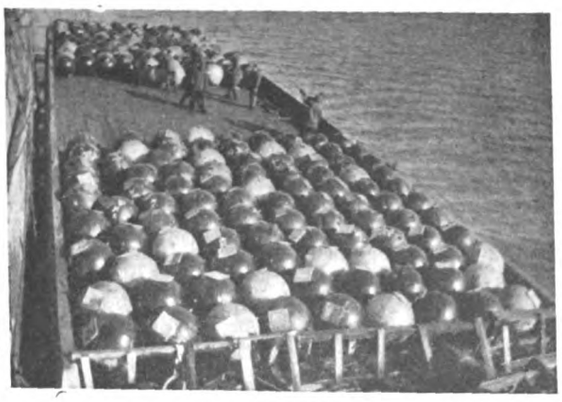

Fig. 3.—Mines Brought to Vessel on Barge

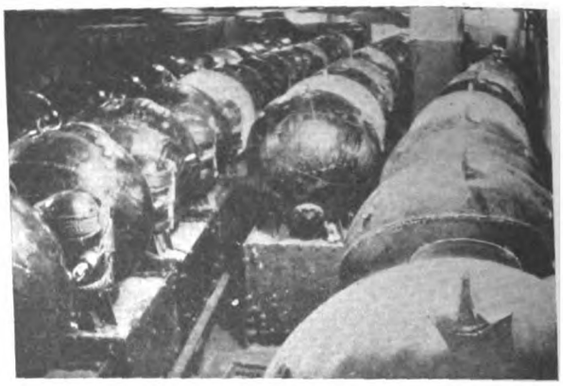

Fig. 4.—Mines Stowed in Hold on Tracks

Saranac, with four elevators each. The electric elevators were placed well forward and the hydraulics amidships and aft of the electrics. All the elevators were of 3,000 pounds capacity, thus carrying two mines on each trip.

Elevator Equipment

Of particular interest are the electric elevators. These elevators were of the "micro-drive" type, an equipment developed by the Otis Company primarily for the handling of freight in terminals, warehouses and industrial plants. They are sometimes termed operatorless elevators, from the fact that no regular operator is required, every movement of the elevators being automatic and controlled by push button operation.

A feature of great importance on this type of elevator is the automatic leveling device. By an ingenious arrangement of the machine, controller and a leveling switch operating with cams in the hatchway, the elevator platform is automatically brought to an accurate level with the floor and maintains that level under all conditions of loading and unloading.

Method of Operation

To illustrate the method of operation of these elevators on the mine-laying ships, let us assume that one of the elevators is at the lower deck ready to be loaded. The mines are stored on channel-iron tracks laid along the deck, the mine anchor being furnished with wheels to run on the tracks, which extend onto the elevator platform. As the first mine is rolled on the elevator, the stretch in the cables may cause the platform to sag a few inches below the floor level. The automatic leveling device, however, immediately brings the platform back to its proper level and the second mine is rolled on without delay.

The proper button is then pushed by the despatcher and the elevator with its load proceeds to the launching deck, where it automatically stops level with the deck. As the first mine is rolled off, contraction in the cables, due to the release of so much weight, may cause the platform to rise slightly above the deck level, when the leveling device automatically restores it to a level position and the second mine is rolled off. The elevator is then despatched to one of the storage decks by the momentary pressure of the proper button.

This continuous method of hoisting the mines made possible their planting in an unbroken line, one mine being dropped from the stern every 11½ seconds while the ship moved at a speed of 12 knots. A total of forty mines was maintained on the launching deck at all times during the planting.

During the period of the fleet's activity there was not a single instance of a break in the continuity of movement of the mines due to interruption of the elevator service.

Oxy-Acetylene Welding in Great Britain.—It is estimated that to-day not less than 30,000 employees in Great Britain are working the process of oxy-acetylene welding. Twenty thousand of these entered the field since the war began. Of the total number, 90 percent are not fully skilled, being mostly employed on sheet steel work for war purposes.

Fig. 5.—Swinging Mine Aboard

Fig. 6.—Hoisting Mine from Barge

Fig. 7.—Mine Leaving Tracks at Stern

Fig. 8.—Premature Explosion of of Mine Just Astern Ship

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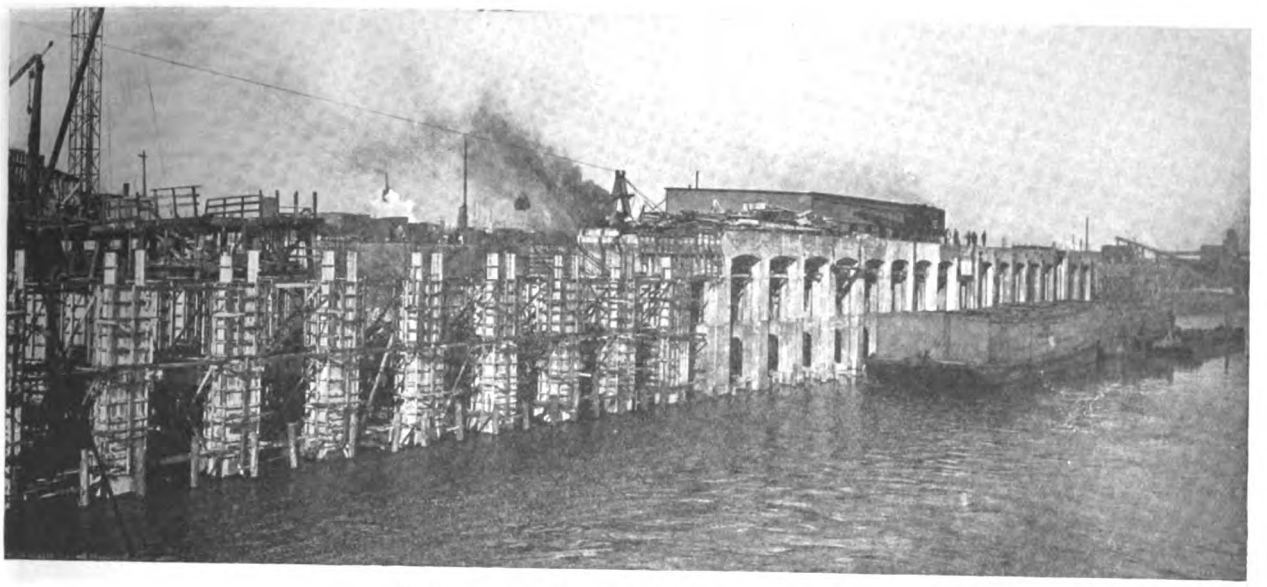


St. Louis Barge Terminal Under Construction

Revival of Mississippi River Traffic—III

Special Structural Features of Barge Terminal at St. Louis—Arrangements of Cargo-Handling Machinery—Terminal Costs

BY M. VON PAGENHARDT*

THE purpose of public river terminals may be summarized as follows:

1. To encourage the revival of river traffic by providing proper connections with the railroads.
2. To furnish warehouse space for boats and shippers.
3. To insure the lowest terminal cost.
4. To extend the benefits of the cheaper water rates.

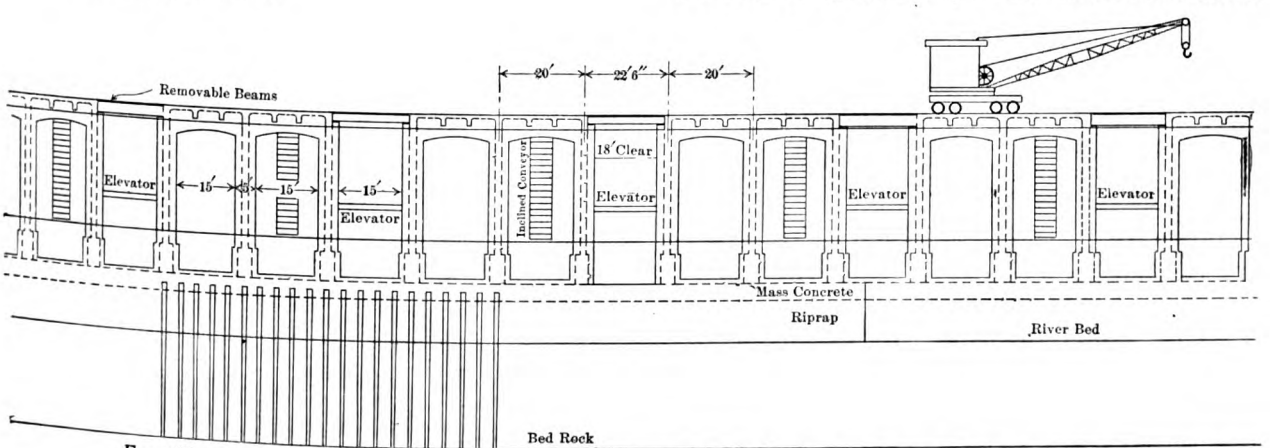
Economical public terminals are essential for short water hauls and of equal value for long water hauls, inasmuch as water-borne freight must bear the expense of loading and unloading.

The handling and terminal expense, whatever it may be, must come out of the water rate, and, as water rates are lower than rail rates, the water haul must be sufficiently long to save enough out of the transportation, maintenance and overhead costs to pay for this double handling. The lower the terminal costs, the less must be set aside for terminal handling and the shorter the distances over which the lower water rates can be applied. Although long water hauls can pay a higher terminal cost than short water hauls, any saving in terminal expense can be applied in lower water rates, thus increasing the effectiveness of the water route and bringing the town with economical river terminals nearer to the world market.

The recommendations of a committee of terminal engineers appointed at the Second Annual Conference of the Mississippi Valley Terminal League, held at St. Louis, February 15-16, 1916, contained outlines of designs for Mississippi River terminals, methods of freight handling, classification of terminals according to their yearly tonnage, and types of dock construction.

In the fall of 1916, the city of St. Louis let a contract

* Naval architect, St. Louis, Mo.



Front Elevation of St. Louis Barge Terminal, Showing Arrangement of Elevators and Conveyors in Units

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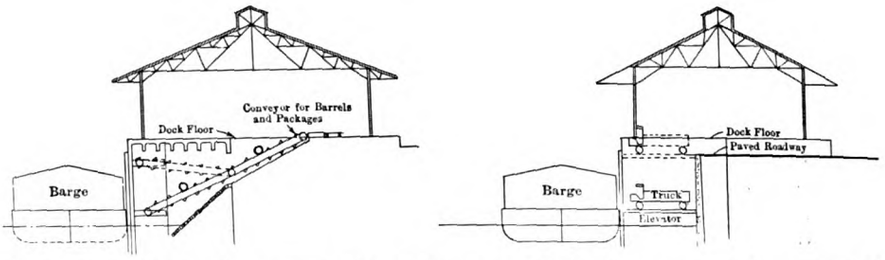
for a public dock and terminal designed by the city's consulting engineer, C. E. Smith. The terminal was located on North Market street, where the city owns a long stretch of waterfront available for present construction and future extension, and at a point where the harbor line was sufficiently far out to provide adequate space for terminals. The location is not far from the business district and is reached by wide paved streets having easy grade. North Market street, for example, is 100 feet wide, with a maximum grade of 2 percent.



Cross Section, Showing Arrangement of Truck Elevator and Incline Conveyor, at St. Louis Terminal

Design and Construction of the St. Louis River Terminal

The cross section shows one of the intermediate bents, there being seven of these in each unit, and two solid walls on either end of each unit adjacent to elevator openings, making each unit 160 feet long exclusive of the elevator. The front elevation shows a section of the completed terminal, 1,000 feet in length.

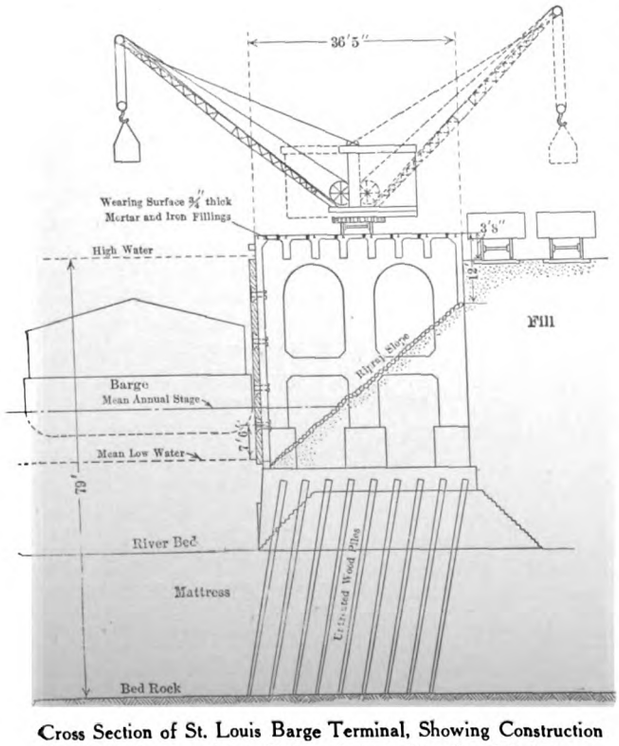
The location of the face of the wall, half way between the two harbor lines, placed it about 250 feet out in the river beyond the bank line, which position, in turn, necessitated the placing of 500,000 cubic yards of fill. The spring flood of 1917 deposited about 100,000 cubic yards of sand behind the construction, the high water of 1918 added 50,000 cubic yards more, and when the water receded the sand fill was within 30 inches of high water. With the river 23 feet on the gage, the total depth of fill in some points amounted to about 25 feet.

Pile Foundation

The pile foundation consisted of 220 rows of 9 piles each, 45 to 50 feet long. These were placed 4 feet apart in each direction and were driven in 35 to 40 feet by the use of a 2-inch jet pipe 50 feet long. In some cases the jet was so effective that the weight of the pile hammer forced the pile 40 feet into the jet hole without striking a blow.

To prevent the river from scouring under and washing away the pile, dikes, woven mattresses made of 1-inch boards, in all 80 feet wide and 1,000 feet long, were sunk on the river bed, parallel with the face of the dock and extending 10 feet under the face of the terminal and 70 feet out into the river beyond the structure.

The space around the pile heads, from the river bed up to 2 feet below zero, was next filled with riprap 8 to 10 feet deep, which was dropped among the pile heads from barges, leaving the pile heads projecting two feet above the top of the riprap.



Cross Section of St. Louis Barge Terminal, Showing Construction of Foundation and Installation of Cargo-Handling Machinery

Concrete Foundation

Temporary piles were then driven 10 feet apart along the face and the back of the structure, the tops of the piles extending to 12 feet above zero. Inside of these piles, plank bulkheads 4 feet high on the back and 14 feet high on the face of the structure were placed to hold the front and back edges of the concrete foundation slab. The pile heads extend into the concrete for a distance of 2 feet. This foundation slab, when finished, will consist of a solid slab of concrete 36 feet wide, 4½ feet deep and about 900 feet long, resting upon and held in place by about 2,000 foundation piles.

The concrete footings are raised above the foundation slab and are connected to it by reinforcing rods. Each of these footings is 4 feet wide, 6 feet long and 7 feet high, extending to the 9-foot level on the gage. Seven concrete bents were placed to each 160-foot unit. At intervals, solid panels were built into the bents and curtain walls were placed between these bents to form vertical shafts for elevator openings.

The concrete floor consists of slabs and T-beams of continuous construction, each unit consisting of eight spans, 20 feet each. The front beam was arched for appearance and added strength. The rear beam was built 12 feet deep to form a partial curtain wall with which to hold back the fill behind the terminal down to the level from which it was permitted to slope under the structure. Six 80-pound rails were imbedded in the floor of the structure; the two outer rails, about 35 feet apart, were placed to support the overhead traveling cranes, the other four rails to form two tracks of standard gage on which railroad cars and revolving cranes may be placed. All rails are bonded together with copper bonds to carry electric current, if required.

Warehouses, Driveways and Tracks

A temporary frame warehouse has been placed behind the first unit, with a railroad track on the land side of the warehouse. Wagon delivery is made on the land side of the warehouse and at each end. Between the dock and

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warehouse a space 24 feet width has been left open for two railroad tracks serving such freight as can be handled direct from boat to car and *vice versa*.

Cargo-Handling Machinery

The terminal is designed for vertical lift machines. Any number of locomotive cranes can be operated simultaneously with overhead traveling gantry cranes. Large truck elevators of 15-ton capacity are to be installed. These will be so arranged that motor trucks can drive from the street onto them and then be lowered to the water's edge. Additional vertical chain elevators for miscellaneous freight are under contemplation.

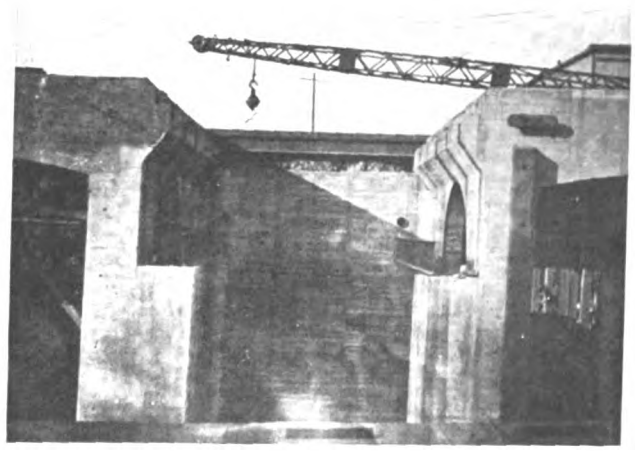
Cargo-Handling Capacity

The capacity of the St. Louis terminal development is entirely dependent on the machinery placed upon it. The ultimate track capacity of this design is for fifty-four cars for the first two dock units of 360 feet, or with only two switchings per day and an average load of 20 tons per car 2,160 tons could be loaded and unloaded per day, which would provide a track capacity equal to a dock capacity of 500,000 tons per year. With the completion of the six units as planned, one and a half million tons could be handled per year if sufficient handling machinery is placed upon the dock. It is expected to actually take care of from 150,000 to 180,000 tons per year by the use of the first two completed units in the coming year.

Terminal Costs

The terminal cost is being defrayed partly by public and partly by private funds. The public cost is the interest on bonds, sinking fund, maintenance, depreciation and insurance, which may be placed at 8 percent of the total investment. If $500,000 (£105,000) is required to build six docking units of a combined length of 1,000 feet, and 500,000 tons of freight are handled by these units, then a fixed charge of 8 cents (0/4) would have to be levied on each ton of freight handled. As a matter of fact, this charge, usually appearing as a wharfage charge, should be partially or wholly absorbed by the city in the interest of the general community.

The switching cost should be considered a semi-public expense, inasmuch as it is in the power of the city properly to protect the boat lines from excessive charges. The remainder of the handling expense—labor, electric power and water—should at a modern river terminal not exceed 20 cents (0/10) a ton for all classes of freight.



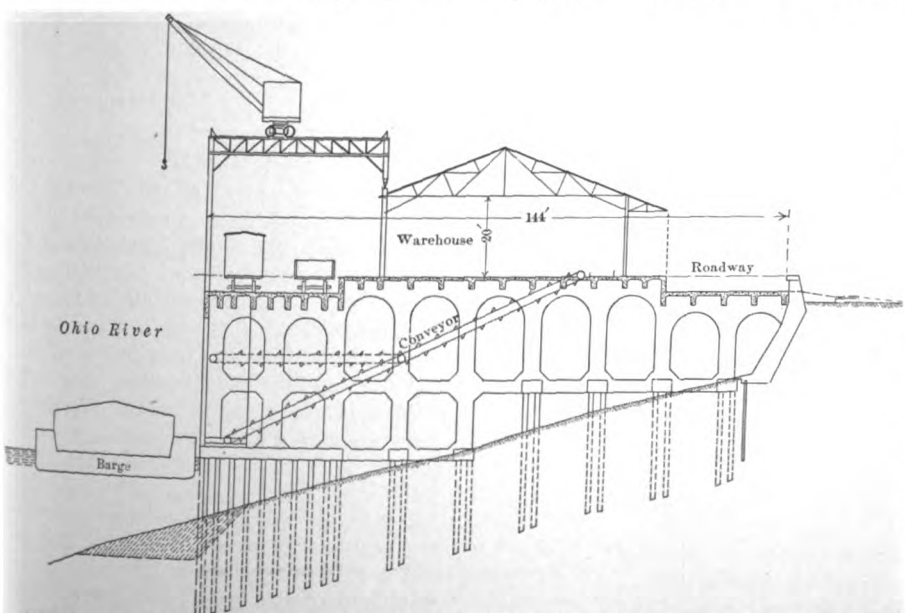
Completed Unit of St. Louis Terminal, Showing Construction Allowing the Removal of Beams

Conclusion

The river cities are beginning to see the necessity for building river terminals, but they are confronted by the difficulty of finding the necessary funds for an expenditure which is primarily public. While large cities like St. Louis or New Orleans can see their way clear to invest in any terminal enterprise justified by the prospective tonnage, smaller cities are not in the same position. On the other hand, since the waterways are now under Federal control and the Government has established barge service on the Mississippi River with an annual tonnage capacity of one million tons for the lower river and a half a million tons for the upper river, definite action must at once be taken in the matter of terminals, or the whole project of general freight traffic by river is doomed to failure.

The cities of Cairo, Helena, Memphis and LaSalle have taken some definite action in preparing plans and estimates for prospective terminals, but final action is everywhere postponed. It appears that the question of terminals cannot be left entirely to the initiative of smaller cities; since the project affects the whole district, and, in the last analysis, the whole country, it should be answered in a definite form by the Federal Government.

At all events, as Senator Reed very wisely said, coincident with the work of development of river terminals, the business interests should organize and arrange to furnish cargoes to the capacities of the boats available. This is the only way to get a fleet in the first place, and the only way to keep it. Without adequate terminals, river navigation will fail.



Cross Section of Proposed River Terminal of Reinforced Concrete for Cairo, Ill. Designed by C. E. Smith

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Advantages of Having the Steamboat Inspection Service Represented in Foreign Countries

In this month's issue it is stated that efforts are being made to keep our consular service abreast of our merchant marine. The idea is good, but, to my mind, what is urgently needed is for our Steamboat Inspection Service to be represented in foreign countries.

It is true that no other nation is so represented, but that is no reason why we should not be. I have heard the thing discussed both pro and con since our merchant marine has started to expand, and can see many benefits to be derived from the plan. There is no doubt but that it would be of the greatest benefit to shipowners to have a credited mechanical representative of the United States Government right on the job when a ship needs repairs.

In many cases it would, I think, tend to keep the cost of repairs at as low a figure as possible, which in turn would save the time of the ship. It would also take a load of responsibility off the shoulders of the captain and chief engineer. In fact, the benefits of the plan are so numerous that it is a wonder that the plan has not been put into effect before this.

In any case, I would like to see the measure discussed, so let us hear from others either for or against it

New York. "ONE HUNDRED PERCENT."

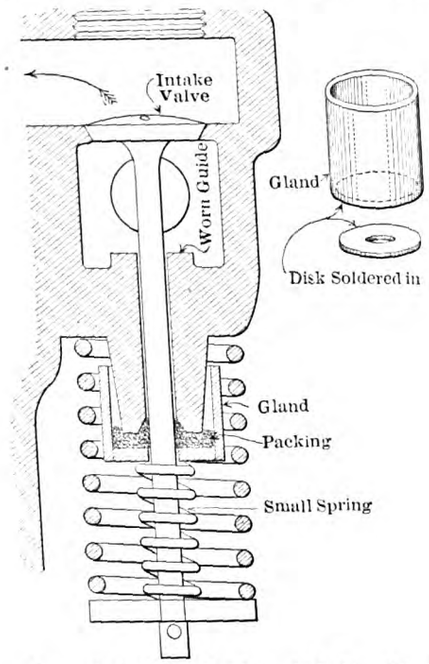
Curing Leaky Valve Guides

The gasoline (petrol) engine of the ship's motor sailer had been steadily losing power, and in spite of frequent examinations of the piston compression and adjustment of the carburetor mixture the trouble continued. Finally one day when the machinist mate was grinding in the intake and exhaust valve he noticed that the valve stems were a very loose fit in the guides, so loose, in fact, that they shook easily and daylight could be seen between the stem and guide. This excessive wear had been caused by long service; the steel stems running in just the plain cast iron guide, no bushings had been installed on this make of engine.

It was this space around the stems of the intake valves that caused the engine to lose power, for on each suction or intake stroke the pistons would pull in through these worn guides a considerable amount of air. This, of course, lessened the ability of the piston pulling in the proper mixture of gas from the carburetor, so that the engine was continually running on a weak mixture and could not develop power. The trouble was temporarily cured as shown in the sketch.

Pieces of brass tube with the disks soldered into the bottom were made to answer for packing glands. Each intake valve was removed, and the bottom of the cast iron guide holes was chamfered to make the packing fit snug to the stem. The valves were put back; the improvised packing glands with some soft packing were slipped on over the stems, and these held up against the bottom of the guides by special small springs that fit inside the regular valve spring. By reference to the sketch, the scheme will be quite clear.

This cured the trouble, and it was only necessary to renew the packing once in a month. One of these days



Improvised Valve Guide and Packing Gland

when the ship goes to sea for a long trip and the old motor sailer is in the skids, we will take the engine out, ream the guides and make bushings for them, which they should have had in the first place.

MACHINIST'S MATE.

Point of Cut-Off

In the February issue, page 114 of the Questions and Answers column, I note in particular question and answer No. 993, relative to point of cut-off. The writer of the answer gives two interesting ways of determining the point of cut-off, and mentions the possibility of there being arbitrary rules in existence that may also be employed for such problems. Here follows a rule that is old, and gives results very close to the methods which appear in the paper. The formula is:

$$x = \left(\frac{2 \times \text{lap} + \text{lead}}{\text{travel of valve}}\right)^2 \times \text{stroke of piston.}$$

In which x = the number of inches of the stroke to be completed. All the dimensions are expressed in inches.

Applying the formula to the problem given in question No. 993, the statement of the question becomes:

$$x = \left(\frac{2 \times 2.5 + .125}{10}\right)^2 \times 42 = 10.03 \text{ inches.}$$

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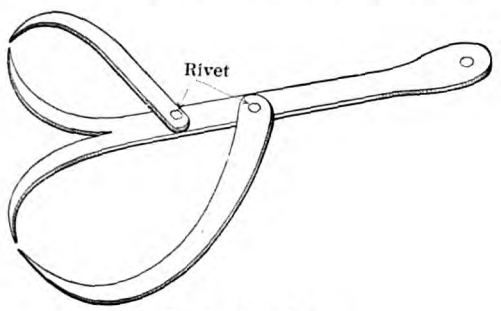
And, 42 — 10.03 = 31.97 inches, point of cut-off from the *beginning* of the stroke. $\frac{31.97}{42}$ = .76 of the stroke, which is at variance with the answer in the paper—.74—by only 2.6 percent, which is sufficiently close when it is considered that the angularity of the connecting rod would change both results.

Possibly some readers may find the foregoing useful in conjunction with the methods that have already been given.

Brooklyn, N. Y. CHARLES J. MASON.

Rough Calipers

Very handy rough calipers can quickly and easily be made from ⅛-inch plate stock, as shown in the sketch.

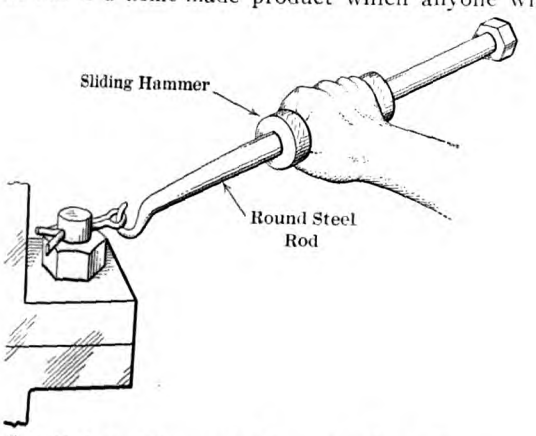


Handy Rough Shop Caliper

The main part is split and forged around to the curves. Two different length legs of suitable curves make it a handy double caliper. W.

Cotter Key Extractor

This tool is a home-made product which anyone with the spare time and material can very easily make. It is a tool that is very desirable to have, for I have found that it is quick and easy to use and also that it is a time and labor saver.



Bar with Sliding Hammer for Extracting Cotter Keys

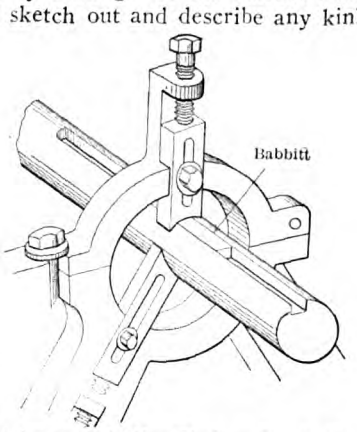
It is made in sizes to suit the user's need. The construction of it is so simple that when you have made one you will want to make another for the larger sizes. The rod is ⅜-inch diameter. One end is threaded for a short distance and a nut is riveted on, then a piece of round stock is drilled and slipped on the rod for a sliding hammer. Next, the end of the rod is tapered off and bent up into the hook, the correct shape being that shown.

The rod should be made of good machine steel, in order that it may be tempered. If it is desired to make it a workmanship-like job the sliding hammer can be turned up in the lath, so that it is a nice fit to the grip of the hand, and each end of it knurled.

Concord, N. H. C. H. WILLEY.

Steady Rest Kink

Once in a while one meets with a problem in lathe work that calls for some extra scheming to get around. It may be the setting up of a piece of work on the face plate, or the improving of special fixtures to make the lathe do milling or key seating. If the marine machinist aboard ship would sketch out and describe any kinks he invents to get around a job, I know that the rest of us would be sure to appreciate it and swap ideas.



Device to Hold Key-Shaft in Steady Rest

The sketch shows a simple stunt that helped me. I had to turn a key-wayed shaft down, and it was necessary to hold the end of it in the steady rest. To do this so that the work would run smoothly was the problem. At first a strip of brass was wrapped around the shaft at the place where it was to turn in the steady rest, but this did not stop the vibration. Then the scheme of pounding in some Babbitt metal and scraping this true with the circumference was tried. This proved the right thing, and the shaft revolved as smoothly as could be desired.

LATHE HAND.

Worth Knowing

The cylinder heads, valve chest covers, caps of main bearings, etc., have special tapped holes for receiving eye bolts or lifting screws, as shown at *A* in Fig. 1, and generally when the time comes to use these threated holes they are chock full of dirt, and time must be spent digging and cleaning them out before the eye bolt or lifting set screw can be put in. To eliminate this trouble, and as a means of preserving the threads of such holes on the machinery of our plant, we use blind screws to plug them when not in use, as shown in Fig. 2, the screws being made from old bolts. Always give the screws a generous coating of graphite grease when they are put in.

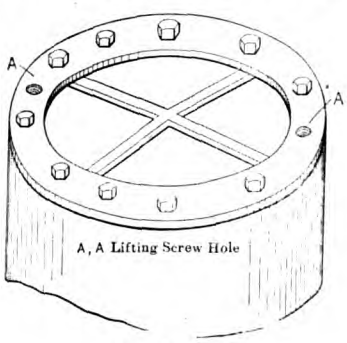


Fig. 1

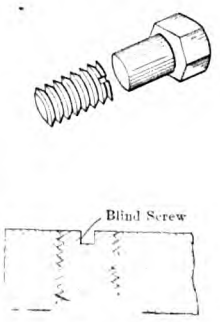


Fig. 2

ENGINEER.

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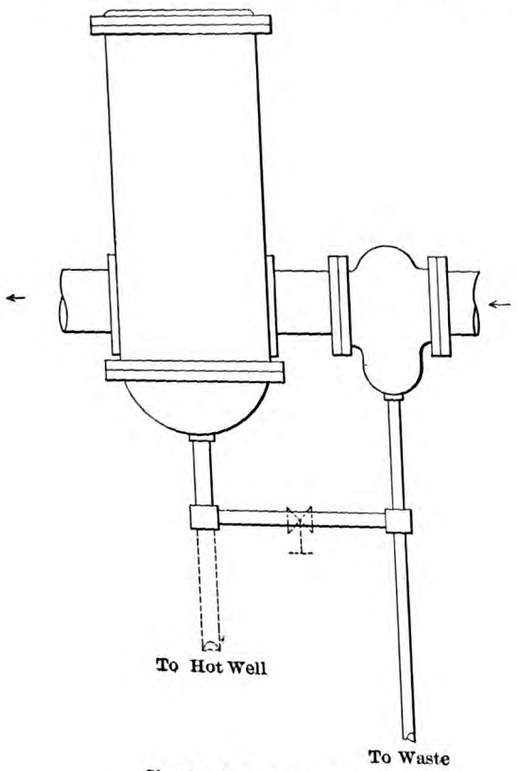
Revising Drainage of Heater and Separator

On taking charge of an ice plant, the writer found a closed heater, preceded by an oil separator, as shown in the sketch, and noticed that the drips from the separator and heater were carried to one trap and blown to waste. The drips from the separator, of course, could not be reclaimed, but the drips from the heater represented pure condensation because the oil was taken from the steam by the separator.

These drips from the closed heater represented a loss of pure water to the extent of 1,000 pounds per hour, and also represented a direct loss in heat, because they were at a temperature of about 190 degrees.

To remedy this condition, the connection from the separator to the trap was maintained, but a valve was put



Sketch of Drainage Connections

in the horizontal line leading from the heater drip, so that the latter could be cut off from the oily waste discharge. The pure returns, after the heater and piping were blown out to free them of any accumulation of oil, were piped to the hot well where the water went to make up a portion of the feed supply.

Philadelphia, Pa. W. A. LAILER.

How High Is a Vacuum?

The lack of a separate system of terminology for mechanical pressures is due, no doubt, to the self-suggesting analogies with altitude, which made the old altitude expressions readily understood in their new applications. It is really difficult to imagine anything more natural than that a large number of pounds pressure should be spoken of as "high," or that a relatively small number of pounds should be known as "low." It is only when we go below the datum level of atmospheric pressure that the analogies become less apparent, and we find ourselves groping among needless inconsistencies and foolish contradictions.

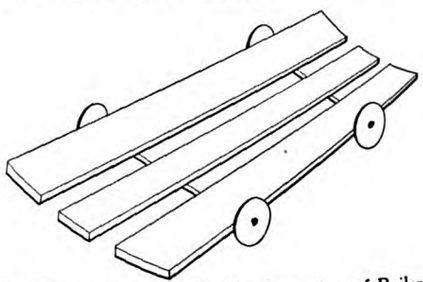
Take a homely example. A man whose property is 500 feet above sea level erects a flagstaff 80 feet high. The top of his flagstaff is 580 feet high, if he is speaking to a topographical engineer; and it is 80 feet high, if he is reeving off halyards. The steam engineer follows him exactly with 14.7 pounds per square inch corresponding to the 500 feet elevation, 200 pounds absolute corresponding to the 580 feet, and 185.3 pounds gage corresponding to the 80-foot flagstaff. But suppose the property owner digs an 80-foot well. The bottom of the well is 420 feet "high" above sea level; and it is also 80 feet "deep" when referred to the surface of the ground—being "high" or "low" according as it is viewed from sea level or from the locality. The steam engineer makes fairly good weather of it so long as he speaks of "one pound absolute pressure," but he gets hopelessly lost when he looks down 13.7 pounds below atmospheric pressure and calls it "28 inches vacuum." He is almost sure to call it a "high" vacuum, which might be permissible, if we could also speak of a "high" well. It is almost equally certain that he will speak of "amount" of vacuum, whereas a man who spoke of "amount" of well or "amount" of flagstaff would be tapped for the simples.

Since we have irrevocably adopted the altitude ideas of "high" and "low" for expressing the relative degrees of pressure, and, since it is unquestionably desirable to be consistent throughout the entire range, it is suggested that the term "deep vacuum" be used instead of "high vacuum," and that the term "depth of vacuum" be used instead of "height of vacuum," "amount of vacuum" and similar expressions.

Washington, D. C. Q. B. NEWMAN.

Handy Device for Cleaning or Examining Boilers

In the inspection and cleaning of large boiler units it is sometimes a tiresome and awkward job to navigate from one end of the boiler to the other. To facilitate this work, some boiler inspectors use a small car designed somewhat along the lines of the sketch. This is made about 3 feet long and 18 inches wide, just large enough to support the torso of the body, leaving the hands and



Car Designed for Facilitating Inspection of Boilers

arms free to work and the legs available to propel the little truck. Wherever frequent boiler cleanings or inspections are made, or where large batteries of boilers are installed and the conditions permit, the use of such a carriage will be found materially to assist in the work of the boiler man.

Philadelphia, Pa. W. A. LAILER.

Remember that brass pipe "iron pipe size" does not come threaded, nor are couplings furnished. Heavy, extra heavy and hydraulic fittings are obtainable. In small fittings they should all screw up 4½ threads by hand.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Pitch of Propeller

Q. (1001).—Please explain a method of obtaining pitch of a propeller. Also what is meant by the term "angle pitch"?

A. (1001).—The plumb bob method is often used and is described in many of the texts. The scheme described below is slightly more accurate and will give the pitch of the propeller of a single-screw vessel at several points of the blade with but little more trouble than is required for one point.

The plan is as follows: Clamp a batten near the aft edge of the rudder, so that a wooden straight edge, when placed horizontal, will bear upon the batten and on the rudder post. Locate a horizontal line by scratching lines A and B on the rudder post and on the batten. The propeller must now be turned so that the straight edge will

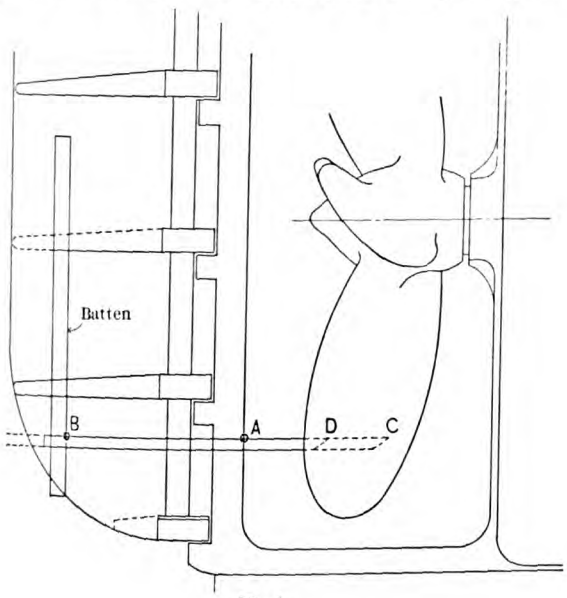

Fig 1

intersect the helical surface of the propeller blade not far from the leading edge. Mark on the propeller blade the point where the batten intersects same (as at C in the figure), also make a scratch on the straight edge opposite A. Now rotate the propeller until the straight edge intersects the propeller blade not far from the following edge of the blade and mark the point D, and another point on the straight edge opposite A. The difference between our two marks on the straight edge will be the portion of the pitch corresponding to the angle the blade has been turned through. It is clear that the following equation will hold true:

$$\frac{\text{Pitch}}{\text{Part of pitch}} = \frac{\text{Circumference}}{\text{Part of circumference}}, \text{ or}$$

$$\frac{P}{\Delta P} = \frac{2\pi R}{\sqrt{\overline{CD}^2 - \overline{\Delta P}^2}} \text{ (approximately).}$$

Where P = pitch.
ΔP = part of pitch (difference between marks made on straight edge opposite A).
R = distance between top of straight edge and center line of shaft.
CD = distance between points C and D measured on blade.

All distances to be measured in the same unit.

The pitch thus obtained will in most cases be sufficiently accurate for ordinary use. If the propeller has very wide blades, points C and D should not be taken too far apart, or the chord ($\sqrt{\overline{CD}^2 - \overline{\Delta P}^2}$) will differ appreciably from the arc.

This method can be conveniently used to obtain the pitch at several points on each blade, from which a fair average can be obtained.

The term "angle of pitch" is not often used, but is the angle which the helix at the blade tip makes with a plane

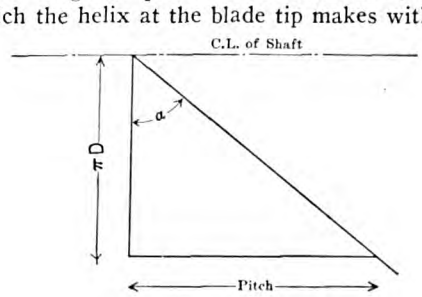

Fig. 2

perpendicular to the shaft axis or α in Fig. 2, which is easily laid out when we remember that the screw will advance a distance equal to the pitch in one revolution.

Development of Shell Plating

Q. (1002).—Will you kindly give me an approved method of developing shell plating on the mold loft floor. Is there a practical method of doing this without resorting to triangulation?

A. (1002).—Practice varies in the different yards as to how much of the shell should be developed in the mold loft. Many yards, however, are lifting only a few of the plates in ordinary cargo steamers.

Concerning the best method of developing shell plate, triangulation is the basis of most of the plans. A very good article on this subject by T. L. Cohee appeared in MARINE ENGINEERING, September, 1917.

Any twisted surface which has straight lines for its traces on a series of parallel planes can be developed; that is, laid out flat. A surface which has curvature both ways is undevelopable and by no direct process of geometry can the true shape or area be obtained.

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Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

ROSSETER PRESENTS SHIPBUILDING PROGRAMME

Four Types of 9,800 Deadweight Tons and Upwards

J. A. Rosseter, Director of Operations of the Emergency Fleet Corporation, has presented a programme for future shipbuilding to the Pacific Coast shipbuilding industry. The following types of vessels are included:

Group 1. A three-deck, shelter-deck, single-screw steel freight steamer, 420 feet over all; 405 feet between perpendiculars; molded beam, 56 feet; molded depth to shelter deck, 30 feet 9 inches, with a carrying capacity of 10,000 tons deadweight, with a draft of 26 feet, equipped with balanced quadruple expansion engines of approximately 4,000 horsepower, and three oil-burning Scotch boilers, with steaming radius of 13,500 knots without bunkering.

Group 2. A three-deck, shelter-deck, single-screw freight steamer, 490 feet over all; 470 feet between perpendiculars; molded beam, 62 feet; molded depth to shelter deck, 43 feet, with carrying capacity 12,500 tons deadweight, with a draft of 29 feet 2 inches, equipped with balanced quadruple expansion engines of approximately 5,600 horsepower and five Scotch boilers, oil burning, with steaming radius of 14,000 knots without bunkering.

Group 3. A three-deck, shelter-deck, steel freight steamer, 522 feet over all; 500 feet between perpendiculars; molded beam, 68 feet; molded depth to shelter deck, 45 feet 6 inches, with carrying capacity 15,000 tons deadweight, and draft of 30 feet 8 inches.

These vessels will be equipped with either twin-screw balanced quadruple expansion engines of approximately 6,600 total horsepower, or single-screw balanced quadruple expansion engines of approximately 6,600 horsepower and six Scotch boilers, oil burners.

Group 4. A three-deck, shelter-deck, twin-screw motor freight vessel, 440 feet over all; 425 feet between perpendiculars; molded beam, 56 feet; molded depth, 38 feet to shelter deck, with carrying capacity 9,800 tons deadweight.

New Ship Contracts

The Prince Rupert Shipbuilding & Engineering Company, Prince Rupert, B. C., has received a contract to build two 8,100-ton steamships.

The Richardson Boat Company, North Tonawanda, N. Y., has a contract for building five 64-foot tugs for the War Department.

Director General Piez Resigns from the Shipping Board

Announcement was made on February 28 of the resignation of Charles Piez, director general of the Emergency Fleet Corporation, to take effect May 1. Mr. Piez, who is president of the Link-Belt Company, of Chicago and Philadelphia, will make his headquarters in Chicago.

Howard Coonley, vice-president in charge of administration, it is reported, will resign about the end of April to return to his duties as president of the Walworth Manufacturing Company, Boston.

$1,724,000 CONTRACT FOR SELF-PROPELLED BARGES LET

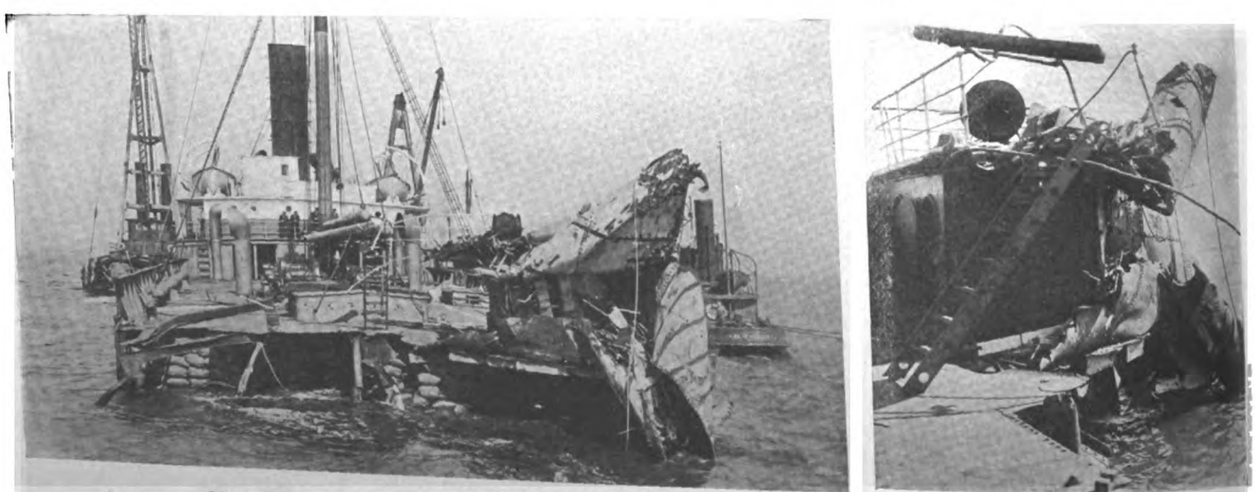
Three Companies Will Handle the Work—Deliveries by September First

The contract for building twenty self-propelled steel cargo barges has been let as follows: To the Terry & Trench Company, New York, 12, at $87,000 each; to the Dravo Contracting Company, Pittsburgh, Pa., 4, at $87,000 each; to Starr & Bennet, Newbern, N. C., 4, at $83,000 each. All barges are to be deliverd by September 1.

These self-propelled barges will be used with the twenty cargo barges, which are being constructed by the Terry & Trench Company, in units of three barges and one self-propelled barge, designed to carry from 5,000 to 6,000 tons. These units are conveniently handled in the Erie locks, which are 310 by 45 feet.

To recapitulate, the contract calls for 20 steam-driven steel cargo towboats; the length overall is 150 feet, breadth 20 feet, and depth 12 feet. Two compound engines supply the propelling machinery, with one oil-burning watertube boiler and auxiliaries, fuel tank and water tank. The engines are 14-inch stroke; 10-inch diameter high pressure, 24-inch low pressure.

Ward boilers are specified, or other approved makes passing the United States Government inspection, of 125 pounds per square inch working pressure, with 1,600 square feet heating surface.



Views Showing the Damages Received by the *Lord Dufferin* as She Was Towed Up the Harbor

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ESTIMATED FINANCIAL STATEMENT OF THE SHIPPING BOARD

Cancellation Costs Given—Other Details Itemized

With the beginning of the year 1919, it is reported that funds available for the contract ship programme totaled $700,000,000. If the current expenditure amounts to $90,000,000 a month or over, only about $150,000,000 will remain on June 30 for future expenditure. Since it is reported from well informed sources that at least $111,000,000 will be needed to cover the claims for requisitioned ships, it is evident that not more than $39,000,000 can be utilized for future building.

A financial statement of the Emergency Fleet Corporation up to February 4, as given out by one of the leading shipbuilding corporations to the New York *Journal of Commerce and Commercial Bulletin*, is summarized below:

Total authorized expenditure...		$2,884,000,000
Less amount set aside for plant, property, docks, marine railways, etc.....		114,662,500
Balance for ship construction proper.....		$2,769,337,500
Total commitm'ts to Dec. 31, 1918.	$2,865,367,841	
Commitm'ts cancelled to Feb. 4, 1919.....	361,404,312	
Net programme Feb. 4, 1919.	$2,503,963,529	
Cost of Cancellations	92,869,088	
Cost of machinery cancellations ..	20,000,000	
Cost of shipyard extensions	13,860,000	
Total	$2,630,692,617	
Administrative expense	35,000,000	
Total		$2,665,692,617
Balance of authorization...		103,644,883
Of the amount above authorized for contract construction, viz..		$2,769,337,500
There has been so far appropriated		1,823,788,500
Balance for which appropriation is required.....		$945,549,500
Deduct		103,644,883
Leaves amount required to complete the contract programme.		$841,904,117
Of this there is needed to June 30, 1920.....		$549,653,254

Halt Building of Battle Cruisers

Secretary of the Navy, Josephus Daniels, has ordered the suspension of work on the six 35-knot battle cruisers already authorized until a decision as to the future type of capital ship has been made.

Because of the difference of opinion among naval experts, the large amount of money involved (between $180,000,000 and $200,000,000), and the great question of fighting efficiency at stake, the Secretary of the Navy has directed temporary suspension of the construction of these vessels.

The United States Navy Yard at Bremerton, Ore., is building two ammunition ships and seven seagoing tugs for the Navy Department. The yard has also entered bids for the building of five auxiliary naval cruisers to cost about $3,000,000 each. Awards have not yet been announced.

Damages for the Lord Dufferin

Three libels claiming $1,650,000 have been filed against the Cunard Steamship Company in connection with the sinking of the freighter *Lord Dufferin*, which was rammed by the *Aquitania* on February 28.

The wrecking derricks of the Merritt & Chapman Derrick & Wrecking Company, 17 Battery Place, New York, were on the scene one hour and a half after the collision occurred, and were able to manage the handling of the ship so that 4,000 bags of sugar in the bow of the vessel were kept entirely dry. The damages include complete destruction of about forty feet of the stern and the breaking of the propeller and propeller shaft.

FOREIGN CONCERNS WISH TO PURCHASE SHIPS

Passenger Steamships, Towboats and Tanker Wanted

A correspondent in France writes to MARINE ENGINEERING as follows:

"If you know of a good passenger and freight mail steamship for sale, please secure full information, prices, etc., for me."

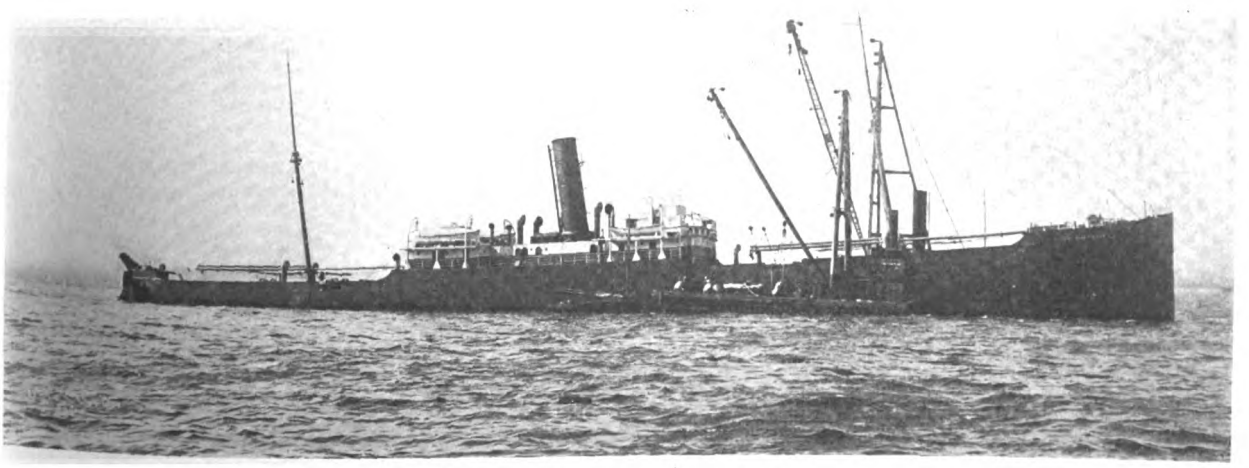
Our correspondent is in the market for towboats 600 to 800 horsepower. He requires full information as well as prices.

A correspondent in France writes to MARINE ENGINEERING that he is in the market for a passenger steamer for day service (paddle-wheel preferred), the vessel to be about 150 feet long and 5- to 6-foot draft.

Another correspondent in Europe, who manages an oil company, informs us that his company is looking for a steamer of about 1,600 tons deadweight, to carry, among other things, about a thousand tons of oil in bulk.

A correspondent in France writes to MARINE ENGINEERING, stating that he is in the market for several small steamers under 4,500 tons deadweight. Letters containing particulars regarding such vessels should give full information as to tonnage, carrying capacity, propelling machinery, type of vessel, lowest possible price and other details needed by a possible purchaser. Address Neuilly, care MARINE ENGINEERING.

Rene E. Bossiere, 4 Place Jules Ferry, Havre, France, writes to MARINE ENGINEERING that he wishes to get into correspondence with American concerns who wish to have agencies in France. He refers especially to manufacturers of shipbuilding materials, plates, shapes, forgings, anchors, chains—indeed almost anything and everything that goes into the construction of a vessel.



The *Lord Dufferin* Minus Forty Feet of Stern

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RETURN SHIPYARDS TO PRIVATE CONTROL

Philadelphia to Have Municipal Drydock

Announcement was made by Howard W. Coonley, vice-president of the Emergency Fleet Corporation, that the yards of the Newport News Shipbuilding & Dry Dock Company, the Baltimore Dry Docks & Shipbuilding Company, the Sun Shipbuilding Corporation, and the Chester Shipbuilding Company would be turned over to private control by April 15.

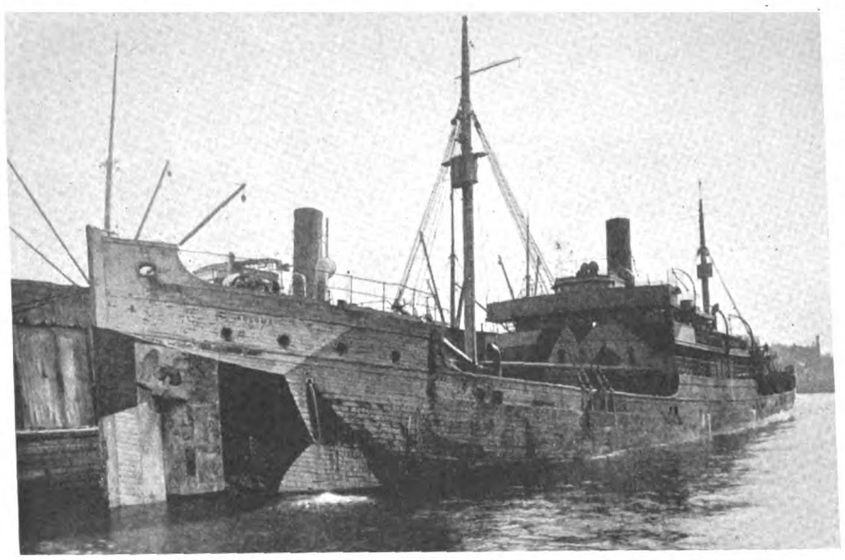
Mr. Coonley has also been reported as promising the construction of three additional drydocks in Philadelphia under the supervision of the Emergency Fleet Corporation, if the city government does not find it advisable to begin construction with city funds.

Causes of the Accoma Disaster

A report issued by the Foundation Company, 233 Broadway, New York, builders of the wooden vessel *Accoma*, which was abandoned at sea after a hurricane on February 11, shows that the leaking of the vessel was due to a complication of causes.

Capt. Phillips testified that before undertaking the trip he had recommended that a steel rudder replace the wooden rudder, since he had experienced the stripping of the steering engine pinion on a previous voyage, due to the rigid construction. When the vessel was in the teeth of the storm the rudder snapped.

The engineer, A. C. Kick, reported that leakage in the port coal bunker, due to damage of the ash ejector, had made it impossible for the bilge and circulator pumps to eliminate the water as fast as it rushed in. He reported also that the contents of the fresh water tank had leaked out, due to inadequate repairs at port, which left the vessel with unequal ballast, so that added to her heavy overloading she was very seriously handicapped for this reason. The propelling machinery, he reported, functioned properly until the water prevented the raising of steam, which in turn made the abandonment of the ship necessary when the bilge pumps were no longer adequate. He mentioned that the leakage at the seams was probably less than might have been expected from the battering of such a heavy sea.



The Heavily Loaded *Accoma* Moored at New York Pier Before Sailing

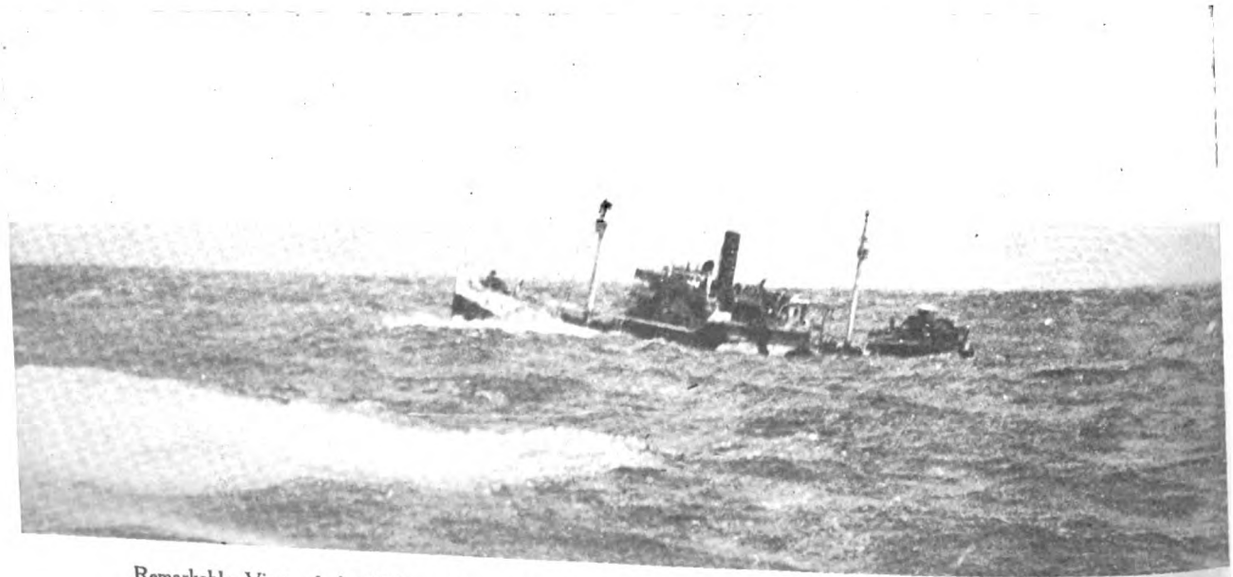
SHIPYARDS STILL PROHIBITED FROM ACCEPTING FOREIGN SHIP CONTRACTS

British Yards Now Opened

Almost daily, progressive shipbuilding concerns are receiving opportunities to build ships for foreign register. Each order or bid which they have to turn down should be a further argument in convincing the Government authorities of the wisdom of opening the yards at this time. We understand that many British yards are filling their books with all the orders they can handle, and are giving guarantees that work will be begun upon the new contracts within eight months, and that ships will be completed within sixteen months. American shipyards deserve the same opportunity.

Col. Wilson has announced that the British Government, after due consideration, has decided not to retain any shipyards for Government undertakings, provided they can be disposed of at fair terms.

The Shipping Board has now opened bids for 428,000,000 gallons of oil to be used on the oil-burning ships operated by the Shipping Board.



Remarkable View of the Sinking *Accoma*, Snapped by Her Steward from the Deck of the Rescuing Vessel

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Fulflo Scientific Cooling for Marine Engines

Three difficulties have been encountered in adopting the centrifugal pump to the pumping of water for cooling marine engines and to the pumping of bilge water: Difficulty (1) in developing a suction great enough to permit of the use of a centrifugal pump above the level of the liquid being pumped; (2) in devising a centrifugal pump of sufficient diameter of impeller to pump the maximum amount of water required at minimum speeds, and to provide for the installation of such a pump in the small space generally available for that purpose; (3) in designing a pump which would deliver a sufficient volume of liquid at the minimum speed and yet not supply too great an amount at maximum speed so that the engine be kept too cool for proper and economical operation.

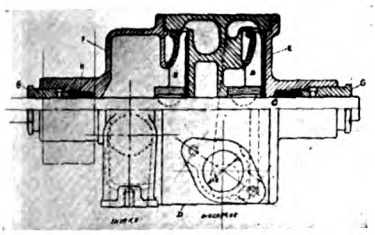

Fig. 1.—Design of the Fulflo Pump of the Duplex Type

These conditions are met, it is claimed, by the combination of the Fulflo twin (duplex) pump and the Flocontrol manufactured by the Fulflo Pump Company, Blanchester, Ohio. This pump, which can be supplied in varying sizes to be used in connection with engines of from 50 to 300 horsepower, retains its prime under all conditions by the use of a priming chamber of the design shown at *F*, Fig. 1, and by the location of both intake and discharge at the top of the pump. When the pump is stopped, the water remaining in the discharge pipe flows back into the pump while the excess overflows through the intake. The priming chamber and pump body, however, retain a supply of water sufficient to create the necessary suction when the pump is again started. Where it is desirable to drain the pump to prevent freezing a drain valve is provided.

With 1¼-inch intake and discharge, this type of pump has a 30-inch suction, with a discharge of 20 gallons per minute at 1,200 revolutions per minute, and a 36-inch suction and a discharge of 40 gallons per minute at 1,800 revolutions per minute.

The Flocontrol, mentioned above, is the name given to the mechanism designed by the same company to control the flow of the Fulflo or any other pump where the capacity of the maximum or minimum speeds is greater or less than may be desired under varying conditions. This attachment can be furnished in various sizes with flanges for connection with pump or intake pipe or with flanges on one end and the other end arranged for brazing.

This apparatus may also be used with the Fulflo centrifugal bilge pump, a modification of the duplex type illustrated, which has but a single impeller. This pump can also be furnished in various sizes to meet specific conditions. When ⅜-inch piping is used, this pump has a capacity of 3 gallons per minute at 1,200 revolutions per minute and a suction lift of 30 inches, with a capacity of 5 gallons per minute and a suction lift of 36 inches at 1,800 revolutions per minute. If ½-inch piping is used, a discharge of 5 gallons per minute is obtained at 1,200 revolutions per minute with a suction lift of 30 inches, and a discharge of 8 to 10 gallons per minute at 1,800 revolutions per minute with a suction lift of 36 inches. No valves are used.

New Apparatus for Removing Thin Rust from Ships' Sides

The rotary scraper machine. designed by the Rotary Scraper Company, Inc., 17 Battery Place, New York, for removing rust and paint from iron and metallic surfaces, has been used to advantage by the Submarine Boat Corporation, Newark, N. J., and the Downey Shipbuilding Corporation, Staten Island, N. Y., for removing thin rust from the ship's sides before painting. A specially constructed spiral brush has been developed for this purpose.

The Division of Operations of the United States Shipping Board has tried out the new machine on the vessels *Nansemond* and *Otsego*. On the former 900 square feet of bulkheads, angle bars and other parts in the bunkers were scaled in thirty-two hours and fifty-five minutes, with two men working the machine. A surface of two square feet was chipped by the machine in sixty-six seconds, whereas hand scraping and chipping of a like area consumed eight minutes. The machine averaged 27.35 square feet of surface chipped per hour. On the *Otsego*, with two men operating the machine in the bunkers, it cleaned 1,500 square feet of angle bars, bulkheads and other parts in thirty-two hours. The better showing on the second vessel was probably due to the fact that the men had become more familiar with the use of the machine, and in consequence were able to do better, faster work. Reports on both jobs show that the work was excellently done.

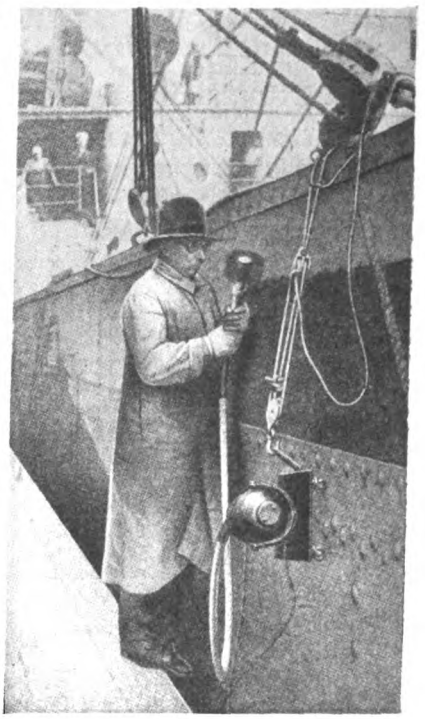

Fig. 1.—Using the Spiral Brush of the Rotary Scraper Company

Besides this special spiral brush the tools shown in the accompanying illustration are regularly supplied with the

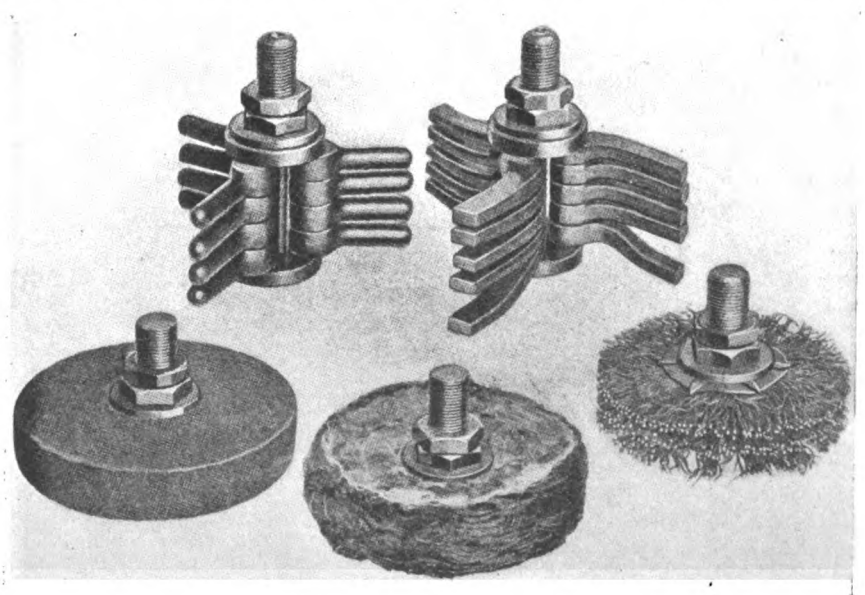

Fig. 2.—Hammers, Emery Wheels and Brushes Used on the Rotary Scraper

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apparatus for various types of work. The complete set of tools consists of three hammer tools, round and sharp, one steel wire brush, one emery wheel and one buffing wheel. These parts are screwed into the handle piece spindle and held by a simple lock nut.

The flexible shaft through which power is supplied consists of an inner core of flexible wire, a flexible casing and a tool holder. The durable construction of the parts makes it possible to run the shaft at a speed of about 4,000 revolutions per minute without overheating. Since the core is provided with identical ferrules at either end, to connect it with the motor shaft and the revolving tool spindle of the hand piece, it can be reversed, which feature adds to the life of the apparatus.

The machine has been used to advantage for scaling boilers, and for grinding, drilling and reaming in foundry and machine shops.

Navy Department Uses Electric Tachometers

During the war electric tachometers, made by the Electric Tachometer Corporation, 435 North Broad street, Philadelphia, Pa., were installed on approximately 120 torpedo boats, destroyers and numerous vessels of other types, such as submarine boats, submarine chasers, scout cruisers, battleships, transports and fuel ships. Practically all ships coming under the jurisdiction of the Navy Department were fitted with electric tachometers; much of this installation work was handled by the Electric Tachometer Corporation.

By the use of tachometers in the engine room and on the bridge, it was possible for the bridge officers to have before them a constant indication of the revolutions of the engine and the consequent speed of the vessel. This knowledge was especially important when vessels were crossing the ocean in convoy formation, in order to insure the maintenance of the prescribed distance between the various units.

This company has lately constructed a new type of electric tachometer which is used on vessels having four propeller shafts. The new design, instead of indicating the speed of the shafts individually, indicates the average speed of the two port shafts and of the two starboard shafts separately. The new apparatus eliminates the expense and extra weight of the differential gearing, since the averaging is done electrically with greater accuracy.

The Fire Gun

A new type of hand fire-fighting device is shown in the "Fire Gun" made by the Fire Gun Manufacturing Company, Inc., 115 Fourth avenue, New York.

A stream of especially prepared chemical solution is forced out by a double-acting liquid pump for a distance of 30 to 40 feet. It is claimed that the apparatus is fool-proof. The composition of the fluid is such that it is a non-conductor of electricity. It will not freeze at 50 degrees below zero, and will not damage machinery. When the stream strikes the heat a solid blanket of non-combustible gas crowds out the air and puts out the fire.

The gun is made in two sizes. The lighter gun weighs 7¾ pounds and holds 1¼ quarts of fluid. The heaviest gun weighs 11 pounds and holds 1¾ quarts of fluid. Separate containers are furnished to hold the liquid for recharging.

One of the fire guns is shown in the illustration.

Fig. 1.—Fire Gun

New Application of Arc Welding

United States letters patent were issued to the Marine Decking & Supply Company, Philadelphia, Pa., on January 28, 1919, for an improved deck construction to be used in connection with the application of cementitious, asphaltic or other deck covering compositions. Originally it was the practice to rough up the steel so that an effective bond would be produced. Later this company instituted a method of fastening clips to the plates by means of tap screws. Under the patent now issued the company is able to accomplish the same results by the use of arc welding, which eliminates the possibility of leakage into the compartments immediately below. The new method is also more rapid.

Pangborn Equipment for Sand Blasting

Sand blasting, as applied to shipyard work, plates and hulls, with the "Pangborn" equipment, is a most effective cleaning method. The hose type machine is particularly adapted to the large work of the shipyard, as the abrasive, always under pressure in the sand-blast chamber, is discharged in combination with the air at gage pressure, thereby obtaining the highest possible velocity. The machine handles all types of abrasive, either sand or metal. The kind of abrasive should be selected with a view to best economy to the work in hand.

Fig. 1.—Pangborn Hose Type of Machine for Sand-blasting

The metal abrasives have many times the life of sand and create less dust, but their high first cost demands an adequate method of reclaiming. For the cleaning of metals to be galvanized or plated, sand is preferable, as experience has shown that the metal abrasives leave particles of fine metallic dust on the pieces, which prevent perfect coating. For general cleaning work, either type of abrasive will be found satisfactory and efficient. Sea sand and silica sands, by their hardness and sharpness, show best economy.

For the cleaning of ship hardware fittings or small parts, an automatic machine of the barrel or rotary table type is best adapted. These machines are made in the continuous operating type of gravity or suction feed, the abrasive being fed to the nozzle, either by gravity or by suction, and discharged in combination with the air. In all types of the apparatus, air pressure and grade of abrasive may be regulated to suit the demands of the material upon which the abrasive is being applied.

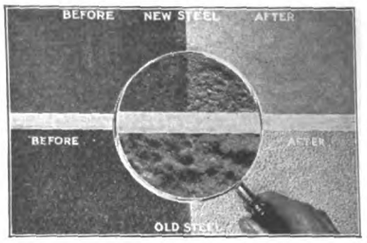

Fig. 2.—Magnified Section of Steel Plate Before and After Cleaning with a Sand-blast

The sand blast, in its various types, is equally adaptable to the cleaning of castings, forgings, stampings, sheet, plate and structural shapes.

Bryant Unbreakable Interconnecting Blocks

The Bryant Electric Company, Bridgeport, Conn., has placed upon the market interconnecting blocks which are made of unbreakable composition. These blocks provide a means of making connections for branch circuits in junction boxes without the labor and difficulty of making soldered connections, taps and tap-offs. The terminal plate binding screws are long, heavy and "staked," so that they cannot be dropped out and lost. The center hole provides for wire entrance from the back of the box if necessary.

Fig. 1

Fig. 2

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Fig. 1 shows a block with a diameter of 1¾ inches and a height of 1 inch. The larger size, shown in Fig. 2, has a diameter of 1¼ inches and a maximum height of 1 inch.

The cartridge fuse base shown in Fig.

Fig. 3

3, which is also made of unbreakable composition, provides the means of fusing a circuit in a regular 4-inch junction box. As will be noted, there is ample room between the fuses for additional circuits to pass through the box. National Electrical Code standard cartridge fuses are used in this block.

Shipyards Contribute Grand Stand

The Todd Shipbuilding Corporation, New York City, financed the building of a large grandstand for the use of wounded soldiers in witnessing the parade which was held in New York City and Brooklyn on March 24 and 25. The men from the Tebo & Robins drydocks contributed their services for the building of the stand.

Wooden Ships Will Bring Railroad Ties East

It has been reported that Portland interests are about to close the charter of five wooden steamers for the purpose of carrying railroad ties to the East. The Railroad Administration is in the market for 100,000,000 feet. The shipping firm of Sudden & Christensen is said to have contracted to carry 7,500,000 feet of the shipment. Should all of the orders for tie material be placed with Washington and Oregon mills it is estimated that fifty or sixty cargo ships will be necessary to bring the shipment to the Atlantic coast.

Mississippi Barge Service Rapidly Developing

The largest cargo of packet freight that has been handled since the opening of the Mississippi-Warrior Waterways service on September 28, 1918, left St. Louis on March 7 by the towboat *Barrett*. The first up-stream capacity cargo is now en route from New Orleans to St. Louis. A. W. Mackie, manager of the Mississippi section of the Mississippi-Warrior Waterways, has reported that service will be operated at full capacity, both up and down stream, if shippers continue to increase their consignments in the next sixty days as they have in the last two-week period. The down-stream cargo consists of 892 tons of package freight; the up-stream cargo consists of 1,250 tons in four barges, towed by the towboat *Choctaw*.

Recent Launchings

Date of Launch	Name of Vessel	Tonnage	Type	Builder	Owner
F.b. 20	W-1	....	Concrete Boat	Great Northern Concrete Shipbuilding Company, Vancouver, B. C.	U. S. Government
Feb. 20	Gustan Hall	9400	Cargo	Virginia Shipbuilding Corporation, Alexandria, Va.	Emergency Fleet Corporation
Feb. 21	Champlaine	1500	Wooden Vessel	Vancouver, B. C.	French Government
Feb. 22	Worcester	....	Cargo Vessel	Groton Iron Works, Groton, Conn.	Emergency Fleet Corporation
Feb. 25	Obak	3500	Composite Vessel	Mobile Shipbuilding Co., Moshico, Ala.	Emergency Fleet Corporation
Feb. 27	Coaxet	9500	Steel Ship	G. M. Standifer Construction Corporation, Vancouver, Wash.	Emergency Fleet Corporation
Feb. 27	Sanpa	3500	Ferris Wood	Housatonic Shipbuilding Co., Stratford, Conn.	Emergency Fleet Corporation
Feb. 27	Gulf Queen	9500	Oil Tanker	Pusey & Jones Co., Gloucester, N. J.	Gulf Refining Co.
Feb. 28	Sangamon	7500	Cargo	American International Shipbuilding, Hog Island, Pa.	U. S. Navy Corporation
Feb. 28	Ingram	....	Destroyer	Bethlehem Shipbuilding Corporation, Fore River, Mass.	United States Navy
Feb. 28	West Cherow	8800	Steel Cargo	Northwest Steel Company, Portland, Me.	Emergency Fleet Corporation
Mar. 2	Wisconsin Bridge	....		Submarine Boat Co., Newark, N. J.	Wisconsin Bridge Co. of Milwaukee
Mar. 2	Milwaukee Bridge	....		Submarine Boat Corp., Newark, N. J.	Milwaukee Bridge Co. of Milwaukee
Mar. 3	23-23	....	Barge	Machias Ship Construction Co., Machias, Maine	Emergency Fleet Corporation
Mar. 3	W-2	....	Concrete Vessel	Great Northern Concrete Shipbuilding Company, Vancouver, B. C.	United States Government
Mar. 3	Aspenhill	3500	Ferris	Coast Shipbuilding Co., Portland, Ore.	Emergency Fleet Corporation
Mar. 4	Unnamed	....	Concrete Car Float	Liberty Shipbuilding & Transportation Co., Cleveland, O.	U. S. Army
Mar. 5	Abilla	3500	Ferris Vessel	Grant Smith-Porter Ship Company, Aberdeen, Wash.	Emergency Fleet Corporation
Mar. 6	Alector	3500	Wooden Vessel	Grant Smith-Porter Ship Company, Aberdeen, Wash.	Emergency Fleet Corporation
Mar. 7	Joseph J. Hock	2000	Barge	Arundel Shipbldg. Co., Fairfield, Md.	Eastern Transportation Company, Baltimore, Md.
Mar. 8	Guardsman	....	Tug Boat	M. M. Davis and Son, Inc., Solomons, Md.	Emergency Fleet Corporation
Mar. 8	R-6	....	Submarine	Fore River Shipbuilding Corporation, Quincey, Mass.	United States Navy
	Unnamed (3)	....	Barges	Murnan Shipbuilding Corporation, Mobile, Ala.	United States Railroad Administration
	Cretefarm	1000	Ferro-Concrete	Warrenpoint, Lough Foyle, Ireland	British Ministry of Shipping
	Mason	....	Destroyer	Newport News Shipbuilding and Dry Dock Company, Newport News, Va.	U. S. Navy
	Briarcliffe	3500	Ferris Wooden Steamer	Russell Shipbuilding Company, Portland, Me.	Emergency Fleet Corporation
	Jennie Flood Kreger	1614	Schooner	Mathews Brothers, Belfast, Me.	Crowell & Thurlow, Boston, and others
	Charles A. Dean	1175	Schooner	R. L. Bean, Camden, Me.	Merchants Marine Company, Boston
	Hull No. 966	....	Steel Ship	Pensacola Shipbuilding Co., Pensacola, Fla.	Emergency Fleet Corporation
	Marguerite Emyss	....	Schooner	Boothbay Harbor, Me.	
	Unnamed	....	Wooden Barge	Murnan Shipbuilding Co., Mobile, Ala.	U. S. Railroad Administration
	City of Pascagoula	....	Wooden Ship	International Shipbuilding Co., Pascagoula, Fla.	Emergency Fleet Corporation
	Hull No. 484	....	Barge	Interlake Engineering Co., Cleveland, O.	U. S. Navy
	S-34	800	Submarine	Bethlehem Shipbuilding Corporation, Wilmington, Del.	U. S. Navy
Mar. 9	Dochet	7800	Steel Steamer	Downey Shipbuilding Corporation, Staten Island, N. Y.	Emergency Fleet Corporation
Mar. 9	McKeesport	9600	Steel Steamer	Federal Shipbuilding Co., Kearny, N. J.	Emergency Fleet Corporation
Mar. 11	Derbyline	12000	Steel Tanker	Bethlehem Shipbuilding Corp., Oakland, Cal.	Emergency Fleet Corporation
Mar. 11	Belisle	5500	Freighter	Hanlon Dry Dock & Shipbuilding Co., Oakland, Cal.	Emergency Fleet Corporation
Mar. 13	Comafran I	1000	Concrete Ship	France	French Government
Mar. 14	Palafox	700	Barge	Palafox Shipbuildnig Co., Pensacola, Fla.	
Mar. 15	Cushnoc	9000	Steel Steamer	Pensacola Shipbuilding Co., Pensacola, Fla.	Emergency Fleet Corporation
Mar. 15	West Munham	8800	Steamer	Columbia River Shipbuilding Corporation, Portland, Oregon.	Portland Oriental Line
Mar. 15	Schenectady	7500	Cargo Vessel	American International Shipbuilding Corporation, Hog Island, Pa.	Emergency Fleet Corporation
Mar. 15	West Aleta	8800	Steamer	Schaw-Batcher Shipbuilding Co., South San Francisco, Cal.	
Mar. 15	West Kasson	8800	Steel Freighters	Long Beach Shipbuilding Co., Long Beach, Cal.	Emergency Fleet Corporation
Mar. 18	George Harbor	....	Steamer	Mariners' Harbor, Staten Island, N. Y.	
Mar. 18	Gannet	....	Mine Sweeper	Todd Shipyard Corporation, Tebo Basin, Brooklyn, N. Y.	U. S. Navy
Mar. 20	Puyallup	3500	Ferris Steamer		Emergency Fleet Corporation
Mar. 21	Bancroft	....	Destroyer	Bethlehem Shipbuilding Corporation, Qiuncy, Mass.	U. S. Navy
Mar. 22	Sarcoxie	7500	Cargo Steamer	American International Shipbuilding Corporation, Hog Island, Pa.	Emergency Fleet Corporation
Mar. 22	Tern	....	Mine Sweeper	The Gas Engine & Power Company and Chas. L. Seabury and Company, Morris Heights, N. Y.	U. S. Navy
Mar. 27	Strathnaver	....	Steamer	Downey Shipbuilding Corporation, Arlington, Staten Island.	Emergency Fleet Corporation
Mar. ..	Daulis	3500	Ferris	Sommarstrom Shipbuilding Company, Columbia City.	Emergency Fleet Corporation
Mar. ..	Bound Brook	....	Cargo Vessel	Submarine Boat Corporation, Newark, N. J.	Emergency Fleet Corporation
Mar. ..	N. P. Doane	....	Tug	Adams Shipbuilding Co., East Boothbay, Me.	Doane Towboat Co.
Mar. ..	I. J. Merritt	....	Tug	A. C. Brown & Sons, Tottenville, S. I.	Merritt & Chapman Derrick & Wrecking Company

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Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEW SHIP CONTRACTS

The Todd Shipyards Corporation, 15 Whitehall street, New York, has received an order from the United States Navy Department to build six self-propelled steel oil barges.

Oceanic Steamship Company, it is reported, is planning to build twelve steel steamers of 8,000 tons each. The work will probably be placed with the Pacific Coast builders.

See also contracts noted on page 302 of this issue.

NEW SHIPBUILDING PLANTS

New St. Louis Shipbuilding Company Formed

Contract for the building of the four remaining self-propelled cargo barges to be operated by the United States Railroad Administration in the Mississippi-Warrior barge service has been let to an organization incorporated as the St. Louis Boat & Engineering Company, St. Louis, Mo. This organization was formed by the following men: Walter A. Windsor, president of the Marietta Manufacturing Company, Point Pleasant, W. Va.; Albert Ruemelli, president of the Ruemelli-Dawley Manufacturing Company, St. Louis, Mo., and Edward A. Faust, former president of the Standard Shipbuilding Company, New York City. The company expects to erect an assembling yard at St. Louis, utilizing the facilities of the parent companies for fabrication work. Cox & Stevens, 15 William street, New York, are the naval architects, representing the United States Railroad Administration, and C. E. Smith & Company, St. Louis, Mo., is the consulting firm for the contractors.

Victoria, B. C., to Have Large Drydock

It is reported that capitalists of Seattle, Wash., are backing an enterprise to have the Dominion Government at Ottawa sanction the construction of a big steel drydock capable of handling vessels up to 25,000 tons at Victoria, B. C.

The Gaspe Shipbuilding & Dry Dock Company, Ltd., Gaspe, Quebec, has been founded to build boats, marine engines, etc., at that place. The company, which is capitalized at $7,500,000, has been organized by T. H. Jopling, H. J. Hyman and Alfred Lacouvee.

The Harbor & Marine Company, Ltd., is the name of the new concern which is being formed at Vancouver, B. C., to build ships for the Canadian Government. The contracts for ships were let to the Victoria Machinery Depot some time ago. C. J. V. Spratt will act as head of both companies.

Bartlett Hayward Company Repair Plant

It is reported that the Bartlett Hayward Company, Baltimore, Md., has completed negotiations for the purchase of land on the south side of the basin in Anne Arundel County, from the Frank Furst Realty Company. The site will be used for a ship repair shop. It is stated that the construction will cost $4,000,000 to $5,000,000.

Wisconsin Shipyard

The Anchor Shipbuilding Company, Washburn, Wis., is in the market for machinery and equipment to be installed in the yards now building on the Crequamegon Bay shore.

Kelly Dry Dock

Work has been begun upon the marine railways for the Kelly Dry Dock & Shipbuilding Company of Mobile, Ala. When completed the plant will have cost about $150,000, and will furnish employment for approximately 250 men. The plant is on the east side of the river, opposite the Mobile & Ohio docks. The docks will be able to handle steel or wooden vessels drawing 18 feet of water and upwards, with capacity of 1,800 to 2,000 tons.

New California Yards

The French-American Shipbuilding Corporation, Los Angeles, Cal., has been organized for the construction of concrete steel vessels to be built at its proposed shipyard, to be located in San Pedro. The initial expenditure for the building construction is about $100,000. The company, which is capitalized at $2,000,000, has appointed W. E. Russell president.

The Santiago Shipbuilding & Dry Dock Company, Santiago, Cal., has received permission to build a shipbuilding and repair plant at the tide lands. About $100,000 will be spent in the preliminary construction, it is reported.

SHIPYARD EXTENSIONS

Contract for building extensions to shipbuilding slips Nos. 2 and 3 at the League Island Navy Yard, Philadelphia, Pa., has been let to W. H. McCloskey, Jr., Philadelphia. The work will include reinforced concrete additions, 122 by 170 feet, with trigger pit and shop facilities. The improvements will cost $295,040.

The Mainland Engineering Company, Ltd., 422 Railway street, Vancouver, B. C., is erecting new shops at Cool Harbor, where the company will break into ship repair work. Propellers have been the specialty of the company up to this time.

Morrison & Beck, 149 South Dearborn street, Chicago, Ill., opened bids about March 15 for the construction of a 80 by 600-foot reinforced concrete floating drydock to be built at Green Bay, Wis., for C. Hartman Company, to cost about $500,000. Twelve centrifugal motor-driven pumps of 1,200 gallons capacity will be installed, and sixteen motor-driven capstans.

The National Concrete Boat Company, Norfolk, Va., has arranged for the construction of six shipbuilding berths at its new plant on the Gilmerton branch of the Elizabeth River, near the Portsmouth Navy Yard. Three of the ways will be used for concrete barges, and the others for tugboats, steamers and vessels of other types. The company has been capitalized at $300,000. H. B. Speir is general manager.

Large Eight-Section Dry Dock

The Cossey shipyard, Tottenville, S. I., has begun work on the second section of the 10,000-ton drydock now being built for the Todd Shipbuilding Corporation, Brooklyn, N. Y. The dock will consist of eight sections, each 90 feet long, 114 feet wide, and 45 feet high; it will contain about 3,000,000 feet of lumber, and will be so constructed that additional sections may be added at a later date. This is the third drydock to be built at the Cossey yard for the Todd Shipbuilding Corporation.

The Astoria Marine Iron Works, Astoria, Ore., has received a contract from the Shipping Board to build a marine railway capable of accommodating vessels up to 10,000 tons gross.

Buffalo Dry Dock Company, Buffalo, N. Y., is preparing to erect a punch shop to cost about $20,000 at its Buffalo yards.

$1,500,000 Yard Shop at Mare Island

Approval has been given by the Bureau of Yards and Docks, Navy Department, for the building of a structural shop building at Mare Island Navy Yard,

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California, to cost $1,500,000. Plans were available on February 24. These called for at least $1,000,000 of steel work in the construction.

$1,000,000 Extension on the Coast

It has been reported that the Moore Shipbuilding Company, Oakland, Cal., which is specializing in the building of 9,400-ton cargo vessels and 10,000-ton tankers, is contemplating extensive enlargement of the present plant, in which at least $1,000,000 will be expended.

Launching Basins Enlarged

A 21-foot launching basin, which runs from Port Aransas to Rockfort, Tex., where the Heldenfels Brothers are constructing 3,500-ton wooden vessels for the Emergency Fleet Corporation, was completed in the middle of February.

The basin of the Peninsula Shipbuilding Company, Portland, Ore., and the water area at the rear of the fitting-out dock, are being dredged to make it possible for vessels to be berthed along the side of the dock.

The Ames Shipbuilding & Dry Dock Company, Seattle, Wash., has received assignment of water area leases by A. M. Gund, of that city.

Bethlehem Steel Corporation's Drydock Completed

The largest floating drydock in the United States, designed by William T. Donnelly, is about completed at the Sparrow's Point plant of the Bethlehem Steel Corporation. The new drydock, which is over 600 feet long, will be able to handle vessels up to 20,000 tons deadweight capacity. The engineers believe that it will be possible to submerge and bring up the dock within thirty minutes.

Machine Shop Enlargements

The Marine Engineering & Drydock Company, Providence, R. I., has ar- two-story building, about 60 by 300 feet, two-story building, about 60 by 300 feet. The structure will be equipped as a machine shop and for other features of boat repair operations.

Oscar Daniels Company, Tampa, Fla., which has an order for ten 9,500-ton freighters, 416 feet long, 54 feet beam, is planning to build a well-equipped boiler shop at the yards.

Ira S. Bushey & Sons, 764 Court street, Brooklyn, N. Y., operating a shipyard at the foot of Twentieth street, has filed plans for the construction of a new one-story tool shop at its Court street docks. The company recently increased its capital from $100,000 to $1,000,000 to provide for general expansion and increased facilities at the works.

The Birmingham Steel Corporation, Birmingham, Ala., has begun construction work on a templet building one story high, 60 by 120 feet.

Government Extensions

The Navy Department is planing for the construction of a spar shop at Portsmouth, N. H., to cost about $60,000. The drawings are now completed by the consulting engineer.

The Carroll Electric Company, Washington, D. C., has entered the lowest bid for installing a power house at the Navy Yard, Portsmouth, N. H., at $42,800.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has received five bids for the construction of a paint shop and storage warehouse at the naval station at Algiers, Ala., as follows: James A. Petty, $22,000; John J. Reiss, $26,600; Crowl Construction Company, $27,989; Richard McCarthy, Jr., $28,970, and Lionel Favret, $31,855.25.

The Navy Department, Bureau of Yards and Docks, Washington, D. C., is about ready to discuss plans for the construction of a galvanizing plant at the Norfolk Navy Yard, to cost about $100,000.

The Navy Department is planning to increase the electric power plant at the Pensacola Navy Yard, Pensacola, Fla. About $75,000 will be expended for the improvement.

New Southern Yard Ready for Actual Shipbuilding

The shipbuilding plant of the Chickasaw Shipbuilding Company, Mobile, Ala., is now completed and ready for the building of steel ships. Steel is being forwarded from the Fairfield plant, where it is rolled for the Chickasaw yards, but the actual work of fabrication has not yet been undertaken. Sixteen hundred houses have been built near the plant to accommodate the necessary force to be employed.

PORT IMPROVEMENTS

Extensive Port Improvements Under Way at Philadelphia

The port of Philadelphia is forging ahead at a rapid pace in carrying out the details of its extensive port development.

Bids have been solicited and were opened on March 27, 1919, for the construction of two additional piers of the Moyamensing Group, known as Piers Nos. 82 and 84, South Delaware Wharves. These piers will be 300 feet wide by 900 feet long. The contract at this time is for the substructure only. Bulkheads will connect the two piers and extend to the north and south of them approximately 200 feet. The estimated cost of the construction of the two piers is $3,000,000.

Plans and specifications are also being prepared for the construction of a double-deck pier to be built at the foot of Allegheny avenue, which will be known as Pier No. 127, North Delaware Wharves. Bids are not yet solicited upon this construction. The estimated cost is about $1,000,000.

F. W. Marks Construction Company, Finance building, has been awarded the contract for building Kennelworth street pier at Philadelphia, Pa. The construction will cost $908,420.

Bids for Improvements at Portland, Ore., Advertised

The Commission of Public Docks, Portland, Ore., has authorized a 300-foot extension to Pier 1, upon which will be built a transit shed 180 feet wide. This 1,200-foot pier, the outer half of which has a two-level structure with a transit shed 180 feet in width, has just been completed. The shed over the remaining area will be completed shortly. Construction of Pier 2, which will be 1,500 feet long by 225 feet wide, has also been authorized. For the present this will be used as an open pier for handling bulk freight and lumber. Bids for both these improvements were advertised about March 24. In the new construction provision is made for installation of gantry cranes, sheerlegs, etc. G. B. Hegardt is the engineer in charge.

J. A. McEachern Company, Portland, Ore., has completed Pier No. 1 of the St. John's Municipal Ferry. The driving of test piles on the site of Piers 2 and 3 is proceeding. The Automatic Sprinkler Company offered the lowest bid for the installation of sprinklers in the warehouses on Pier No. 1, at $54,904.

Fourteen 1,000-Foot Piers for New York Harbor

Frank E. Lonas, 1790 Broadway, New York, has presented a proposition to the Sinking Fund Commission of New York City for the building of fourteen 1,000-foot piers in Jamaica Bay. He proposes to pay $1,050,000 for a fifty-year lease of the property. At the end of this time piers and improvements are to be turned over to the city free of cost. In turn Mr. Lonas asks that the city give the builders tax exemption on the property during the fifty years' lease, and that a channel be dredged in Jamaica Bay 1,500 feet wide by 30 feet deep, using the excavated material for filling in around the proposed piers.

Bids for New York Terminal Improvements Costing $400,000 About to be Opened

During March contracts for $400,000 worth of terminal improvements to be built around New York harbor will be let. Lewis Nixon, State Superintendent of Public Works, gives out details of the work as follows: Barge Canal terminal and frame freight house, Flushing, $162,590; grading and paving at terminal sites at Mott Haven, Greenpoint and Gowanus Bay, $94,340; erection of two 1½-ton electric overhead wharf cranes on Pier 6, New York, $28,000; erection of electric capstans and trolley hoists along the canal, position not yet designated, $15,000; erecting four 3-ton, semi-portable, revolving jib cranes, two each at Greenpoint and West Fifty-third street, New York, $92,589; constructing barge terminal freight shed at Pier 93, West Fifty-third street, $53,969; and installing battery-charging motor generator sets, $7,800.

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Drydocks for Philadelphia

The Girard Dry Dock & Construction Company, Philadelphia, is one of the bidders for the management of two drydocks which are to be constructed at Philadelphia aided by funds from the Emergency Fleet Corporation. The company proposes to invest $1,000,000 immediately and the same amount at a later time. The company holds a fifty-year lease on 1,400 feet of water frontage, which has been approved as a site for the new construction. Construction plans have been completed by the Hugh Nawn Construction Company, which guarantees that facilities for repairing ships can be furnished in six months. The project will cost about $5,000,000. The Emergency Fleet Corporation is prepared to furnish 70 percent of the capital at 6 percent interest for ten years.

$4,000,000 Dry Dock at Charleston

Bids will be advertised about April 4 for the construction of the large $4,000,000 dry dock which was authorized by the last Congress to be built at Charleston, S. C.

Harbor Development for Portland, Me., Under Consideration

The State Board Commission has recommended that bonds to the amount of $1,500,000 be authorized for the initial cost for developing Portland, Me., harbor. It is recommended that a pier be constructed to extend from Commercial street to the present harbor line, a distance of 1,000 feet. The Commission points out that the advantages accruing to the city of Portland through the location of the pier at that port should make it worth while for the city to provide a site for the pier and railroad connections without expense to the State.

Officials of the Canadian Pacific Ocean Steamship Line are seriously considering the utilization of Portland, Me., as the Eastern American terminal for this service. The plan provides for the location of a State pier in Portland, with railway connections to be developed from the Maine Central Railroad at Cookshire Junction. The most up-to-date cargo-handling facilities are to be installed.

$2,000,000 for Piers at Tacoma

The city of Tacoma, Washington, is planning to spend about $2,000,000 in the construction of two piers. One pier will be used for open storage and assembling of lumber cargoes. It is proposed that the other pier shall have a transit shed constructed on one side with the necessary mechanical freight-handling equipment needed for extensive shipping. The other side will be developed in the future. Frank A. Walsh is city engineer.

Seattle Plans in Abeyance

Consummation of the plans for the enlargement of Smith Cove, Seattle, is being held up by the delay of the State Legislature in the passing of a bill which will give the city further bonding privilege. The Harbor Commission is arranging with the representatives of the United States Shipping Board to provide extra warehouse storage space.

Buffalo Plans Port Expansion

An organization, composed of vessel owners, elevator managers and officials from steel and iron industries of Buffalo, N. Y., has been formed to advance river and harbor improvements at that city. Edwin T. Douglass has been appointed temporary chairman of the organization, known as the Buffalo Harbor Improvement Association.

Terminals for Oil Companies

Contract has been let to the Raymond Concrete Pile Company, Munsey building, Baltimore, for the building of a reinforced concrete and steel pier for the Standard Oil Company, to cost approximately $400,000. A one-story shed of concrete will be erected on the pier.

The General Petroleum Corporation, Seattle, Wash., is planning to spend $400,000 for the erection of an oil storage plant and a 600-foot ocean wharf near the northwest corner of Harbor Island. W. A. Dudley is district manager.

The Texas Company, Jacksonville, Fla., has commenced important terminal improvements at this port, including the building of additional docks and warehouses on property previously owned by Upchurch Lumber Company. The Mexican Petroleum Company is constructing a barge of 2,000-barrel capacity to be operated at the Talleyrand avenue terminal.

The Mexican Petroleum Company has applied to the Harbor Board of Baltimore, Md., for permission to construct a bulkhead at Fishing Point. It is reported that a refinery to cost about $1,000,000 will be built on the site. A pier for the use of the company's steamers is also reported to be in contemplation. Application for building privilege has not yet been entered. The Mexican Petroleum Company is capitalized at $78,000,000.

Navy Department Contracts Awarded

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the following contracts:

Building of a paint shop and paint storage building at New Orleans, to James A. Petty, for $22,000; installation of piping and equipment and a power plant at New York, to the Lord Construction Company, New York, for $42,069; extension of pneumatic tube system at Hampton Roads, Va., to Standard Carrier Company, New York, $27,637; boiler installation at Pearl Harbor, Hawaii, to Mr. Ewery, Hilo, Hawaii, $1,609; installation of refrigerating plant equipment at Wards Island, N. Y., to Frick Company, Waynesboro, Pa., for $21,074; additions to crane runway on shipbuilding slips 2 and 3, at Philadelphia, Pa., to the American Bridge Company, Washington, D. C., for $137,300; building of substructure for foundry and piers A, B and C, Philadelphia, Pa., to the Wark Company, Philadelphia, Pa., for $7,695; five bronze propellers for 7,500-ton concrete tankers, to William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., for the lump sum of $39,295; five propellers of the same type to Paul S. Reeves & Company, Inc., Philadelphia, Pa., for the lump sum of $38,112; special work in the building of a power plant at the New York Navy Yard, to cost $9,925, to the Guarantee Construction Company, 140 Cedar street, N. Y.

The McLean Construction Company, Fidelity building, Baltimore, Md., has received a contract for building a boat basin and wharf bulkhead at Indianhead, Md., for the Navy Department. The construction will cost $38,900.

G. A. Fuller Company, 131 State street, Boston, Mass., has received a contract for building a storage shed and steel shack at the yards of the Boston Navy Yard. The construction will cost about $75,000.

New Port Projects

The city of New London, Conn., through a special committee of bankers appointed by Mayor Morgan, has decided to limit the issue of bonds for port improvement to $500,000 for the present. Further limitation has been suggested in restricting the amount of bonds to be expended in this connection to the sum of $200,000, or $250,000 during any one year.

Cincinnati, Ohio, has passed an ordinance providing for the expenditure of $178,500 for water-front improvements.

The city of Tuscaloosa, Ala., will issue bonds to the amount of $25,000 for the purchase of a wharf site east of the waterworks above Lock 12. A bond issue of $50,000 is also available to erect a suitable landing and equip it with modern cargo-handling machinery.

New Orleans, La., Port Commissioners have been authorized to issue bonds for $8,000,000 to be expended in finishing the construction of the Industrial Canal, and for constructing coal storage facilities, enlarging cotton warehouses and installing coal-handling machinery.

Fort Peirce, Fla., has voted to issue bonds to the extent of $80,000 to construct an inlet from the Atlantic Ocean into Indianhead River. McMullen & Horton are the contractors.

Coos Bay, Ore., is considering the construction of a dock for the use of vessels entering that port.

Contract for building a pier and bulkhead in Bodkin Creek, Md., was awarded to Dorsey Miller Company, Baltimore, Md., on March 6.

Government Work in Prospect

Proposals were opened on March 8 for furnishing two steel boiler feed tanks to the Emergency Fleet Corporation on Inquiry No. 1303-H. No award is yet announced.

The Bureau of Yards and Docks, Navy Department, Washington, D. C.,

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has invited proposals on the erection of one 2,300,000-gallon steel water tank at an estimated cost of $15,000, at Providence, R. I.

Proposals are open for the building of a timber wharf at Norfolk, Va., estimated cost of which is now given as $80,000.

A $15,000 water tank is to be erected at Newport, R. I., under the direction of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

A fire protection system to cost about $30,000 is to be installed in the Navy Yard, Philadelphia, Pa., under the direction of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

At the galvanizing plant to be built at Norfolk, Va., several large cranes are to be installed, for which bids are now open at the Bureau of Yards and Docks, Navy Department, Washington, D. C.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., is about to open proposals covering the installation of two 15-ton electric traveling cranes at an estimated cost of $70,000

The Bureau of Yards and Docks, Navy Department, Washington, D. C., will open proposals on March 24 for the building of a wet basin boat shed at Pensacola, Fla., at an estimated cost of $60,000.

Bids are open after March 17 for the building of a steamship and navigation building at Annapolis, Md., for the Navy Department. The construction will cost about $800,000.

The army warehouse and wharf at New Orleans, La., will be completed. Work was temporarily suspended at the yard pending a decision of the War Department.

The Government will rebuild the wharf and quarantine station at Port Morgan, Mobile, Ala. The construction will cost about $20,000. T. Judge is the contractor.

The Vilter Manufacturing Company, 872 Clinton street, Milwaukee, Wis., has entered the lowest bid of $20,935 for the building of a refrigerating plant equipment at Ward's Island, New York, for the Navy Yard.

The building of a $500,000 dry dock by the Bruce Dry Dock Company, Pensacola, Fla., has been approved by the Shipping Board.

Bids on Rudders Withdrawn

The United States Shipping Board has announced to prospective bidders on inquiry No. 1270, revised (date February 28, 1919), for forty rudders to be placed on 3,500-ton wood ships, that no award will be made on the above bids, since a number of changes in the design of steel rudders are contemplated.

Barge Canal Terminal

The lowest bid for the construction of the barge canal terminal at Greenpoint, Brooklyn, was received from Post & McCord, New York, for $75,718.94. The State engineers had placed the cost of the work at approximately $99,710.

The Matson Navigation Company has requested the Board of State Harbor Commissioners of California to install electric wiring on Piers Nos. 30 and 32 in San Francisco harbor. The company is in the market for various types of electrically-operated labor-saving devices which will be installed on these piers.

A new $125,000 coal hoist, recently installed at the L. N. Railroad Company's docks, Mobile, Ala., makes it possible to unload two coal cars every fifteen minutes. This represents one of the many improvements which have been installed to provide for adequate handling of the Warrior Barge Canal shipments.

Crane Transferring Costs in the United States

As evidence of the cost of cargo transference by adequate crane facilities, the harbor master of the city of Beaumont reports that on March 6 there was handled from ship to pier the following amount of freight: 2103 barrels of asphalt, lift 40 feet, swing 50 feet, in eight hours and thirty minutes at a cost of $25.16 to the shippers for the use of the gantry cranes, which was at the rate of $.002 per pound or $.012 per barrel. The crane expense to the shipper including the profit accruing to the city for the use of the crane is about 4.4 cents per ton.

Larger Ships to Be Built Under the New Programme

It has been reported that under the new shipbuilding programme the Northwest Steel Company, Portland, Ore., and the Columbia River Shipbuilding Corporation, Portland, will each be awarded contracts for the building of five 12,500-ton steel vessels. The vessels will be of a three-decker type and carry reciprocating engines of 5,500 horsepower.

The G. M. Standifer Construction Corporation, Vancouver, B. C., which had previously received cancellation orders on five of the fifteen ships under construction, has been asked to furnish a report of the material on hand for these ships. It is reported that three will probably be constructed as originally planned.

Reinstatements have been received by the Northwest Steel Company for two vessels on the original contract of ten, by the Columbia River Shipbuilding Corporation for two vessels on the original contract of eight, and by the Albania Engine & Machine Works for two on the original contract for four.

General Manager Frank McLaughlin, of the Mobile Shipbuilding Company, Mobile, Ala., has reported that instead of the cancellation of contracts which provide for the building of twenty-four 5,000-ton steel vessels to be built at that yard, the contract will probably be changed so that twelve of the ships will be of 9,600 tons each.

It was announced at the monthly meeting of the American Ship Building Company, Cleveland, O., on February 26, that no change in the shipbuilding programme at that yard was expected.

When relieved of Government work the Groton Iron Works, Groton, Conn., plans to build standard vessels for the United States Steamship Company, which is controlled by C. W. Morse. The rumor that ships built at the Groton and Noank yards of the Groton Iron Works, and at the yards of the Virginia Shipbuilding Corporation, Alexandria, Va., were to be purchased by a company known as the American-Canadian Corporation for $76,000,000, is reported to be without foundation.

New Plan for Conversion of Wood Ships Halts Work on Ship Machinery

The order of the Emergency Fleet Corporation, affecting the California, Oregon and Washington districts, to convert the wood ships now building into schooners and barges, has temporarily stopped all work at the outfitting plants on the coast. The Astoria Marine Iron Works, Astoria, Ore., which is installing machinery upon boats built in that locality, the Grant-Smith-Porter Company, Portland, Ore., which is equipping vessels built at the Portland and St. Johns yards, and the Pacific Marine Iron Works, which has contracts for fitting out hulls built at St. Helens and Columbia City, have closed down temporarily until the extent of the conversions is known. The Willamette Iron Works, which had contracts for outfitting six of the vessels being constructed by the G. M. Standifer Construction Corporation, is also affected. Orders covering engines under construction at the Pacific Marine Iron Works for the G. M. Standifer Construction Corporation and for the Supple-Ballin Shipbuilding Company's ships, are suspended pending further reports.

As to wooden vessels, only cancellations for twenty-six vessels have been put through. Thirty-eight schooners or barkentines are now on the ways, and eighty-eight have already been delivered.

The Coos Bay Shipbuilding Company, Marshfield, Ore., has received reinstatement on contracts for building two of the Ferris type vessels under construction at its yard, since work was far advanced on these particular vessels.

The Terry Shipbuilding Company, Savannah, Ga., has temporarily laid off about 700 men at that plant pending further orders from the Emergency Fleet Corporation regarding the disposition of ship hulls now in construction at that yard.

J. A. Rosseter, director general of operations of the Shipping Board, and Franklin D. Roosevelt, Assistant Secretary of the Navy, have stated that they will use every opportunity to keep shipyards, which are temporarily slack in work, busy upon repair work.

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General Shipyard News

The Columbia Engineering Works, Portland, Ore., delivered the four-masted schooner building for C. Christensen, 32 Broadway, New York, on March 20. The company is also building a 1,000-ton twin screw motorship for the same party.

M. M. Davis & Son, Inc., Solomons, Md., during the year 1918 launched twenty vessels—one 1,800-ton barge for the Northern Transportation Company, one tug for the Bethlehem Steel Corporation, fourteen 600-ton barges for the Quartermaster's Department of the United States Army, and four tugs for the Emergency Fleet Corporation.

The company has under contract for delivery to the Emergency Fleet Corporation eight tugs, 133 feet in length.

It is rumored that the Skinner & Eddy Corporation, Seattle, Wash., has taken over the contracts from the firm of J. Coughlan & Sons, Vancouver, B. C. The latter company was building steel ships of 8,800 tons.

In a statement given out by the shipyard owners in Seattle, Tacoma and Aberdeen, Wash., on March 11, on which day it was expected that the shipyards would again be opened for construction work, the employers estimated that the loss in wages alone during the present shut-down has amounted to $10,950,000.

The second annual convention of the Mississippi Valley Waterways Association will be held in St. Louis, Mo., at the Hotel Statler, on April 17 and 18.

PERSONALS

The Institution of Civil Engineers, London, elected upon its roll of distinguished honorary members on January 28 the following: Marshal Foch, O. M.; Field Marshal Sir Douglas Haig, K. T., and Admiral Viscount Jellicoe, of Scapa, G. C. B., O. M.

VICE ADMIRAL FRED W. GRANT has been assigned as commandant of the Washington Navy Yard and superintendent of the arsenal there.

JOSEPHUS DANIELS, Secretary of the Navy, left for Europe on March 15, accompanied by Rear Admiral D. W. Taylor, head of the Bureau of Construction and Repair, and Rear Admiral Robert S. Griffin, head of the Bureau of Steam Engineering, to study European naval construction with a view to formulating plans for the future naval programme of the United States.

GENERAL GUY E. TRIPP, formerly president of the Board of Directors of the Westinghouse Electric and Manufacturing Company, has been decorated by the United States Government with the distinguished service medal for his excellent work in systematizing methods and practice in the Ordnance Department.

CAPTAIN J. F. BLAIN has resigned as manager of the North Pacific district of the Emergency Fleet Corporation, the resignation to take effect April 1.

Formal announcement was made on March 9 of the resignation of Bainbridge Colby from the United States Shipping Board, in which organization he has served as commissioner since August 8, 1917. No successor has yet been announced.

CAPTAIN W. A. MAGEE, who has been active in the wood ship division of the United States Shipping Board, will succeed Captain Blain as manager of the Pacific Coast division.

REAR ADMIRAL ROBINSON will succeed Captain William R. Rush as commandant at the Boston Navy Yard.

J. J. DAVIS, secretary-treasurer of the Galveston Wharf Company, has been appointed agent for the United States Shipping Board in Galveston with jurisdiction over Texas territory.

MAJOR MARSHALL R. PUGH, who previously served as post engineer at the Bordeaux embarkation camp, is now engaged in work with the United States Shipping Board in the contract department.

REAR ADMIRAL JAMES H. GLENNON has been appointed Commander of the third naval district with headquarters at New York, following the retirement of Rear Admiral Nathaniel R. Usher.

CAPT. NICHOLAS JELUSICH, who has acted as inspector for the Reading Company at the Coastwise Shpibuilding Company's yards, Baltimore, has returned to Philadelphia. During his appointment in the yard he supervised the construction of fifty-two ocean-going vessels. Ten of these, aggregating 17,000 tons, were built at the Locust Point yard of the Coastwise Shipbuilding Company.

MELVIN P. BILLUPS has been appointed assistant director of the Southern Division of Operation of the United States Shipping Board. His appointment became effective February 15.

UNITED STATES ENGINEER W. D. FAIRCHILD, in charge of locks and dams on the Monongahela River, is incapacitated for work on account of a severe breakdown.

H. L. STOUT, chief investigator of the plant protection bureau of the United States Shipping Board, stationed at San Francisco, has resigned.

CHRISTOPHER M. GORDON has again been appointed president of the Los Angeles Harbor Commission, Los Angeles, Cal.

CAPT. W. N. HART has been named superintendent of the Hampton Roads district of the United States Shipping Board.

MAJ. GEN. WILLIAM M. BLACK, chief of the army engineers, has been appointed chairman of the Port and Harbor Facilities Division of the Shipping Board.

MAJ. JOHN C. CUSHING, it is reported, will succeed A. B. Clegg as assistant director of the Shipping Board's Division of Operations in New York.

HENRY W. B. ZUNDT, manager of the New York branch of the Department of Shipping Information of the United States Shipping Board Emergency Fleet Corporation, has tendered his resignation to take effect April 1.

WILLIAM T. DONNELLY, consulting engineer, New York City, has been retained to make a survey of the harbor of Mobile, and to suggest necessary harbor improvements. The survey will include the examination of the Arlington dock development plans and a report of the work already completed and that still in contemplation.

JOHN TORRENCE has been elected president of the Shipping Federation of Canada.

COL. PETER O. KNIGHT, of Tampa, Fla., who has been active for several months as general counsel and vice-president of the American International Shipbuilding Corporation at Hog Island, has returned to Tampa. In the future he will be at Hog Island only when particular circumstances make his presence necessary.

OBITUARY

HENRY ROGERS MALLORY, one of the most widely-known steamship men in America, formerly president of the company bearing his name, and retired president of the Atlantic Gulf & West Indies Steamship Lines, died suddenly on March 4 at Winter Park, Fla.

Mr. Mallory became president of the New York & Texas Steamship Company in 1893. In 1906 the Mallory interests were merged with several other large and important steamship companies. In 1908 a reorganization of the members composing the various steamship lines was carried out. Mr. Mallory, who was chairman of the reorganization committee, placed the business of the present firm on a substantial foundation. In 1915, when Mr. Mallory retired from active business life, it was reported that the Atlantic Gulf & West Indies Lines were worth more than $100,000,000.

Henry R. Mallory

HILARY A. HERBERT, Secretary of the Navy during Cleveland's second administration, died at Tampa, Fla., March 6.

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